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BRIEFLY TOLD.

THE END OF THE YEAR.—This issue brings to a close our Sixty-first Volume and its date is that of the last day of 1894, which year has been an eventful one to the gas makers in many respects. A twelvemonth ago the general business of the country was in a most unsettled condition, and depression ruled the roost, while the lawmakers of the nation were indisposed to take decisive and speedy steps in determining the weighty questions affecting the commerce of the country that had been stirred up by the politicians in their efforts to establish a new cause for their palavering existence. In common with other manufacturers the gas makers felt sorely the effects of the weakness and unquiet of the times, and instead of the recital of the continued and steady gains in sendout of the prior 10 years, the story of a shrinkage in output had to be told. Whatever else may be said about the gas men by those who do not know practically much about the business of gas manufacture, it has not yet been said by any that the gas maker is unable to face a situation, no matter how desperate or involved it may be, without pretty soon finding a remedy to apply to the smoothing it over. In any event the doleful situation was very much in evidence a twelvemonth ago, and it is also so that our gas men were equal to the emergency, for today the trouble has been surmounted and once more the records show that gains instead of losses are generally in order. While much of this satisfactory state of affairs is traceable to an increased and an increasing volume of general trade, another very fair factor in the welcome accomplishment is the close attention to economy that has been observed in the general working of gas plants; not that the wages of the men have been cut, nor that the plan of skimping has been followed, but rather that the closest kind of application to the careful watching of details respecting manufacture and distribution was observed. As a rule, raw materials have been at very low figures, and especially was this the case in the instance of all kinds of iron and fireclay supplies. The economies practiced in the engineering department were ably supplemented by the alertness displayed by the office forces, and judicious, intelligent and persistent canvassing played no mean part in holding business already secured and in supplementing that by the taking on of new customers. The gain in the direction of increasing the use of gas for fuel purposes was nothing short of remarkable, and this was particularly so of the larger centers—exceptionally so in the instance of this city. The improved Welsbach burner, too, proved a most successful offensive weapon without regard to district; and, to sum it all up in the tersest way, all pulled together for the common good, and the result was victory. Towards the close of January we will furnish our figures of outputs for the corresponding final halves of 1893–94, and in the meantime we can report, from conversations had with the officers of many gas companies throughout the country, that the business is rapidly approaching the normal state that it enjoyed for the decade prior to 1893. Speaking for ourselves, in the instance of the measure of success which has been the portion of the JOURNAL during the last year, we have much to return thanks for. Our patrons have appreciated our efforts and have sustained us royally in them, and thus upheld we are ready to go on, in the future as in the past, in our endeavor to represent their interests in the manner best calculated to advance the same.

FIRST CONVENTION OF THE SUPERINTENDENTS OF THE AMERICAN GAS COMPANY.—The American Gas Company's clever General Manager, Mr. George G. Ramsdell, after much patient planning, seems finally to have put the various properties of the American Gas Company on a nice basis of system and order, and those who have been fairly familiar with the original plan of the Company's operations know that the reaching of such a basis meant the expenditure of time and thought. Our speculations in the above regard were brought about by the information that the first convention of the Company's Superintendents was held something over two weeks ago, in the Grand Pacific Hotel, Chicago, at which the Superintendents of all the Company's Western properties were present, with a fair representation from the Eastern division. The meeting was in every sense a success, and it is quite certain that the assemblages will be convened annually.

NOTES.—A bond issue amounting to over $500,000 is to be made on the gas properties of Atlanta, Ga., the control of which is vested in the United Gas Improvement Company.——The rates agreed upon by the Trustees of Alameda, Cal., for the furnishing or supplying of electric currents to consumers for lighting purposes in that city are as follows—the plant is operated on municipal account: For 16-candle power incandescents, 10 o'clock circuit, 85 cents per lamp per month; 12 o'clock circuit, $1.25; all-night service, $2.25. Meter rates, 20 cents per 1,000 watts; lamp renewals to be at the expense of the consumer. Arc lamps (1,200-candle power), 10 o'clock circuit, $8 per lamp per month; 12 o'clock circuit, $12 per month.——The proprietors of the Kansas City Gas Light and Coke Company have applied to the Council of that city for a new franchise, section 2 of which prescribes the rates that may be charged and the manner of fixing the same when a change is necessary because of the reaching of a certain annual sendout. The section is as follows: "The illuminating gas which shall be furnished hereunder shall be of not less than 22-candle power. The rates which may be charged under this ordinance for gas furnished to others than the city, and which rates said grantee, its successors and assigns are hereby authorized to charge, are as follows: From the 1st day of March, 1895, and until the amount of gas sold by said Kansas City Gas Light and Coke Company, its successors or assigns, to others than the city, for use in Kansas City, exceeds 300,000,000 cubic feet per annum, not exceeding $1.40 per 1,000 cubic feet. When such sales of gas per annum reach 400,000,000 cubic feet, but do not exceed 500,000,000 cubic feet, not exceeding $1.30 per 1,000 cubic feet. When such sales of gas per annum exceed 500,000,000 cubic feet, and until they exceed 700,000,000 cubic feet per annum, not exceeding $1.25 per 1,000 cubic feet, and thereafter not exceeding that rate until a new schedule of rates shall be agreed to by the parties. All bills may be rendered at a rate which shall exceed by 15 cents per 1,000 cubic feet the rates named above, provided that upon all bills so made out and paid at the Company's office within 10 days after the expiration of the period during which the gas charged for was supplied a discount shall be allowed of 15 cents per 1,000 cubic feet, so as to make the net rates those named above. For the purpose of ascertaining the rates to be charged hereunder, the grantee, its successors or assigns shall, on or before the 15th day of January in each and every year, after March 1, 1895, file with the City Comptroller a statement of the gas sold to others than the city for use in Kansas City, Mo., during the year ending with the 31st day of December preceding, and the rates chargeable for the the then current year beginning January 1st shall be fixed upon the above schedule according to the amount of such sales." The Company asks that the ordinance be given a life of 30 years, and it agrees to pay into the city treasury 3 per cent. per annum "of all its receipts from the sale of gas to others than the city for use in Kansas City."——Certain residents of South Boston, Mass., have petitioned the Board of Gas and Electric Light Commissioners to order a reduction in the gas rate of that district, and a hearing thereon will be had at an early day. The net rate in South Boston is $1.30 per 1,000.——David Wilson has instituted suit for damages against the Sioux City (Ia.) Gas Company, said damages having been the result of his having inhaled illuminating gas that entered his sleeping apartment because of a fracture in the Company's mains, the fracture having occurred because the mains were not buried beneath the frost line. The escaping gas followed a sewer drain into plaintiff's room, and the house was not piped for gas.——The proprietors of the St. John (N. B.) Gas Light Company have announced their intention of putting the following new schedule of gas rates in force on February 1st, 1895: For illuminating purposes, $1.85 per 1,000, less 10 cents for prompt payment; for cooking, heating and power purposes, $1.35 per 1,000, less 10 cents for prompt payment. These are very low rates for that district, and it is the third reduction made by the Company since the fire which some years ago so greatly retarded the growth of the city.

A New Platinum Standard of Light.

The London *Journal*, in commenting on the subject named in the heading, remarks that search for a perfect and universally acceptable standard of light is still going on in every part of the world where science is cultivated. Several makeshift units of light are meanwhile in common use for such practical work as cannot wait for the universal standard of measurement which is not yet in sight; but nobody pretends to be quite satisfied with any of them. What has actually been done by the foremost European nations in this respect gives fresh point to the well known tale about how three men of science—English, French and German—were once set to describe a camel. The Englishman read up the subject in books of travel, and went to look at the real animal in a menagerie. He eventually produced a description of the creature, reliable enough for anybody who wanted to know about it for practical purposes, but unsystematic, confused, and in parts contradictory. The Frenchman looked at a picture of a camel, skimmed an author on natural history who had never been out of France, and produced a charming essay, brilliantly written, apparently full of scientifically arranged information, and utterly useless owing to omission of important matters of fact. The German sat at home, and evolved a camel out of his own inner consciousness. In regard to the question of standards of light, the action of England and France has been exactly upon the lines of this parable. We have several working standards, and there is a Board of Trade Committee of scientific and practical men who are supposed to be engaged in reducing them to order, and settling what to recommend for general use in legal tests of the illuminating power of gas. But the whole subject is sadly confused and greatly lacking in logical treatment. France has a universal standard unit of light, sealed with the approval of several science congresses, and not used by anybody. In order to mend matters, French science divides this non-existent unit by 20, and calls the result a decimal candle; whereas it is neither a decimal nor a candle, and has no more real existence than the hypothetical original. Here, however, the parallel with the camel essay fails; for the Germans, so far from being content with something evolved from human consciousness, have produced the handiest and most practical standard of light in existence. Yet the amyl-acetate lamp is little used, if at all, by other than German hands.

The possibility of making a reliable standard of light by the aid of platinum has long tantalized physicists, who have reason on their side for condemning all standards depending upon the operation of a wick, and for entertaining grave suspicions as to the reliability of any standard involving combustion. Recently two German investigators—Herr O. Lummer and Herr F. Kurlbaum—have once more taken up the study of platinum with this object; and they have communicated their views to the *Electrotechnische Zeitschrift*. They admit that there can be no question of an absolute unit of light, referable to physical quantities, because it is a physiological effect. At the same time, it is argued that we may conveniently deal with a technical or working unit of light. But the distinction only means that the former should be something that is above everything convenient, cheap and easily produced; its accuracy being a question of more secondary importance, and determined by the character of the work to be done by it. A physical unit may be taken to mean something that is beyond all things accurate; its capacity for easy reproduction being a secondary consideration. Of all the proposed working standards of light of which the German Technical Institute—the Reichsanstalt—has cognizance, only the Hefner-Alteneck lamp is regarded as fulfilling all the requirements of a practical light unit; and the Institute has for some time past undertaken to standardize it.

This standardization, however, necessarily presupposes an accurate physical standard of reference; for which purpose the Reichsanstalt officials have had nothing better than a series of incandescent electric lamps (which had been compared among themselves) supplied by a current capable of regulation to 0.01 per cent. This expedient is, however, unsatisfactory; and to replace it by a definite and reproducible unit of light has long been the most important optical problem at the Reichsanstalt. First, the authorities paid the Violle platinum standard the compliment of reproducing it, both according to the author's method and later by electrical heating. The experiments showed that the results were affected both by the purity of the platinum and the nature of its surface; and the unit was therefore provisionally abandoned.

The Siemens platinum unit was also found inadequate—to the extent of 10 per cent. or more—in some hundreds of experiments. These experiments, however, indicated that absolutely pure platinum is a very suitable material for displaying an incandescent surface. But it was also shown, on the other hand, that neither the melting nor the solidi-

fying point of platinum could be taken as the datum temperature without considering the conditions. Hence a new method of attaining and preserving a constant temperature had to be sought, since it seemed a fair inference that the light radiation from a surface at a given temperature would always be the same.

Several devices to produce a constant platinum unit were tried. One was successful; although, as might have been expected, it did not turn out to be at all an easy thing to do—requiring, indeed, a complicated and delicate apparatus and skillful manipulation. With respect to accuracy, however, the authors show that it can be sufficiently well reproduced, several standard apparatuses having been constructed, all agreeing with each other within 1 per cent.

The definition proposed for the new unit is the light emitted by a surface of 1 square centimeter of platinum at a certain temperature defined by the ratio of two quantities of heat radiation—one being the total radiation emitted by the platinum, the other being that proportion which passes through a certain absorbing medium. If, for example, these quantities have the ratio 10 : 1, the temperature of the platinum may be thus expressed. These quantities are to be measured by a rise of temperature manifested by a balometer placed in their path. The absorbing medium is defined as a quartz vessel, with parallel sides of given thickness, enclosing a volume of water of given thickness. Means are employed to keep up the temperature of the platinum, which need not be stated in thermometric degrees, as it is assumed and found that at the same temperature the platinum will always emit the same amount of light.

In the apparatus constructed upon these principles, a piece of sheet platinum is rendered incandescent by electric current, and has in front of it a diaphragm with an aperture 1 square centimeter in area. The rays passing through this hole strike upon a balometer—first with the whole radiation, and, secondly, after interposing the absorption vessel. The ratio of these two radiations is shown by the galvanometer deflections. The current which heats the platinum is varied until the two radiations have the ratio of 10 : 1; and when this ratio is established the light emitted by the platinum through the hole in the diaphragm is considered as the standard unit of light. The platinum strips used are about 25 mm. wide, 60 mm. long, and 0.015 millimeter thick; and they are set up with their length horizontal. The current required is from 50 to 80 amperes at 32 volts, passing through an ammeter and regulating resistances. The strip of platinum is surrounded by a circu'ating water jacket: and the diaphragm has to be protected in the same way. The absorption vessel has quartz sides 1 millimeter thick, and the layer of water is 2 centimeters through.

It is of capital importance in judging an arrangement of this character, to recognize the possible sources of error, and their value. There is a complexity of apparatus here, adjusted to give an extremely sensitive result; and the physical sources of error are many—to say nothing of the observation errors. The water jacket is stated to be very efficient in maintaining the constancy of heat of the platinum, so far as this has to be assured by external shielding. It was found that an alteration of 1 per cent. of the galvanometer deflection meant a difference of 3 per cent. in the light; and this deflection can be determined by a series of observations to 0.7 per cent. The extent to which the standard may vary through this cause is, therefore, about 0.3 per cent. As to the surface of the platinum, which volatilizes in use, it is stated that the chemically pure metal becomes as smooth as a mirror, and gives errors not exceeding 0.5 per cent. The size of the hole in the diaphragm must be accurately known; but an error of 0.2 per cent. is likely to arise with the most careful measurements. The preparation of the absorption vessel must also, it need scarcely be said, be exact. The balometer has to be carefully calibrated.

After these preliminary experiments at the Reichsanstalt, it is considered that the reproduction of such a standard of light as the one in question—the apparatus having been once constructed—is fairly simple, and its accuracy to 1 per cent. appears assured. It is, at all events, intended to use this unit for the future at the Reichsanstalt for standardizing work. The value assigned to the new unit is not stated with reference to the Hefner-Alteneck or other familiar quantity of light. The proposers of the new unit have been sharply criticised by Herr von Hefner-Alteneck, who, entirely undismayed fly the name of the Reichsanstalt, strongly objects to the distinction set up between what are called "working" and "physical" standards, if it is sought to show thereby that his lamp is not just as "physical" as the new platinum device. If the term "physical" here means simply "accurate," then it is to be supposed that the Violle and Siemens standards must be classed as "unphysical," because they are so very inaccurate. But the Lummer and Kurlbaum unit rests on the same basis, and is neither better nor worse for the description given of it by its proposers.

Herr von Hefner-Alteneck claims emphatically that the standard of light which bears his name is in no need of standardizing by the pedantic methods of the Reichsanstalt—being simplicity and accuracy itself, so far as the construction of the lamp and the constancy of the combustible are concerned. If one lamp differed in lighting effect from another burning the same fuel, then it would be necessary to refer both to a common datum; but it is the essence of the case for the amyl-acetate lamp that this discrepancy does not occur. The accuracy of the lamp standard in question is only limited by a liability of the flame to differ in height, and to be otherwise affected by atmospheric influences which have not yet been fully investigated, but which apply to every flame burning in air. It may be expected that these difficulties will be removable, or the value of the disturbances determined, so that no practical objection shall remain on this score. But in any case it is no good to compare lamps with a unit unaffected by such atmospheric conditions; and one cannot supply standardized air in which to burn the lamps.

Herr von Hefner-Alteneck carries the controversy into the enemy's country by roundly declaring that since 1884, when the Violle unit was nominally adopted as the international unit of light, it has been seen of none; and its adoption was not only a complete failure, but the blunder has stood in the way of a better agreement on the subject. However, as proposals are constantly being made for comparing standards of comparison used in photometry with a unit of light, Herr von Hefner-Alteneck states that such a comparison, even with a perfect standard of light, would be quite superfluous and useless. He argues that the search for a unit in photometry can only be of use if it is directed to the distribution to the widest possible extent of a source of light capable of actual use in making measurements, as a unit of light in itself. It is conceivable, Herr von Hefner-Alteneck remarks, that physical problems may crop up demanding the highest possible degree of accuracy in light measurements, so that considerably increased trouble and cost should be of little importance. Then the new platinum unit may be used with advantage—being a certain standard, and a step in advance in photometry. But such cases may be left to be dealt with by themselves; they are altogether apart from the wide outer field of physical and technical photometry to which the amyl-acetate standard is so well adapted, according to German opinion—though why opinions should vary with nationality on such a subject is hard to understand.

Allen's Apparatus for the Manufacture of Gas.

On December 18th U. S. Letters Patent (No. 531,144) were granted to Mr. Walter A. Allen, of this city, for an improved apparatus for the manufacture of gas. Using the words of the specification:

My invention relates to improvements in apparatuses for the manufacture of gas, and particularly of illuminating gas, from coal, liquid hydrocarbons and water; and the main purpose of the invention is to reduce the cost of the manufacture, and to produce an illuminating gas of high candle power from a small amount of material, by carefully utilizing all of the volatile components of the oil or liquid hydrocarbons for carbureting purposes.

It has been the practice to carburet crude water gas by atomizing liquid hydrocarbons with steam in a heated chamber to which the crude water gas is admitted, the mixing of the particles from the atomizer with the gas being effected in such cases under unfavorable conditions. The steam forms an envelope about the particles of hydrocarbon and thus prevents the heat from effecting in them the necessary atomic change to enable their elements to separate and recombine with the gas in the passage through the heated checkerwork of the chamber. Consequently, when the protected particles meet a highly heated surface or come into direct contact with a solid, the envelope is broken and much of the hydrocarbon is precipitated with corresponding loss as an illuminant. The steam requires for its decomposition a much higher temperature than the hydrocarbon, and if not decomposed—and it seldom is—it carries away the heat rapidly and without benefit. Indeed, it is injurious to the hydrocarbons and it is practically impossible to maintain a proper temperature in the combining chamber for any length of time while making a run. Furthermore, under such conditions, the steam or aqueous vapor carries out of the fixing and combining chamber some of the heavier products of the liquid hydrocarbon protected against the heat by the steam, and these particles are not utilized by combination with the crude gas. As soon as the temperature of these products is lowered the heavier hydrocarbons throw down tarry matter and carry with them many of the lighter products which would otherwise have been utilized as illuminants. On the other hand, if the hydrocarbons of the higher series meet high temperature, or even the proper temper-

ature, too suddenly, they will break up and precipitate anthracene or some other of the higher series of solids, and these are not only lost as illuminants, but they tend to clog up the apparatus.

It has also been a common but objectionable practice to admit the hydrocarbon vapor into the combining and fixing chamber at a point

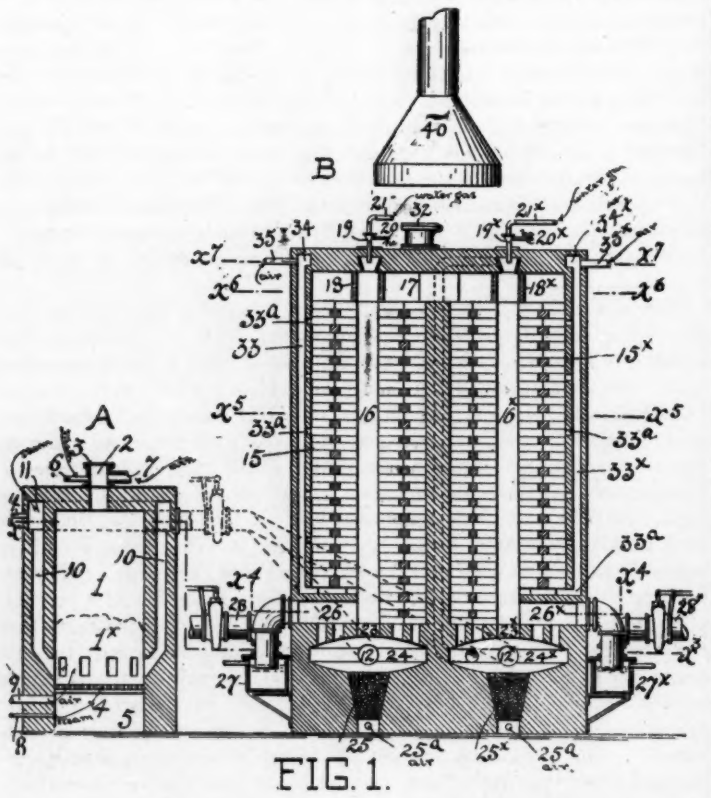

FIG. 1.

where all of the different series of hydrocarbons, from methane (CH^4) of the lower series up to the highest, or solids, meet the same temperature, and are subjected to the same time and travel. This treatment, if it should be adapted to the higher series, will be disastrous to the lower series, and these hydrocarbons will be broken and precipitate lamp black or free carbon. On the other hand, if the temperature be adapted to the lower series of hydrocarbons, no chemical change will be produced in the higher series.

Another feature which I deem objectionable in the ordinary methods and apparatuses is the loss of heat at the purge valve in blowing up, when the hot products of combustion pass directly into the air or through reheating devices. This heat can be utilized in the apparatus to a considerable extent.

Another feature of the ordinary methods which I deem objectionable is the custom in such apparatuses as have double chambers connected below, of attempting to drive or "wash" the heat downward.

My invention seeks to obviate the above objections in process and apparatus.

In the accompanying drawings, which illustrate an embodiment of my apparatus, Figure 1 is a vertical mid-section of the generator and the combining and fixing apparatus, the connections being indicated in dotted lines. This view does not show the two parts in their preferred relative positions. Fig. 2 is a side elevation of the combining and fixing apparatus, the generator behind it being indicated in dotted lines. Fig. 3 is a horizontal section of the generator and fixing apparatus in substantially the plane indicated by line x^3 in Fig. 1. Figs. 4, 5, 6 and 7 are horizontal sections of the combining and fixing apparatus taken in the planes indicated, respectively by the lines x^4, x^5, x^6 and x^7, in Fig. 1.

A represents the generator, as a whole, and *B* the combining and fixing apparatus as a whole. These will be, by preference and for convenience arranged with respect to each other as seen in Fig. 3. The arrangement seen in Fig. 1 is merely for convenience of illustrating both parts, *A* and *B*, in one figure. For convenience also the generator and fixing apparatus are represented with their bottoms on the same level, but this is not essential. The generator will usually be set at a lower level, so as to bring the connecting conduits into a horizontal position.

The generator will be built of refractory material inclosed in a metal skin or casing.

1 is the generating chamber, to which coal is admitted at an inlet, 2, provided with a tight cover 3. The coal rests on a grate 4, above which is the combustion chamber 1*, and under which is the ashpit 5. Steam is admitted to the chamber 1, through a pipe 6, which taps the fuel inlet, and an air blast is admitted at an inlet 7, which also taps the fuel inlet. Below the grate there is an inlet pipe 8 for steam, and an inlet pipe 9 for air under tension. Flues 10 lead from the combustion chamber up through the walls into an annular flue 11, at the upper part of the generator. A conduit 12 (see fig. 3) receives the gases from the flue 11 and carries them off, and a conduit 12* receives the gases from the upper part of chamber 1 and carries them off. A steam inlet pipe 14 is provided to supply steam to the annular flue 11.

The combining and fixing apparatus *B* is constructed of refractory materials, with an oval cross-section and has a casing of sheet metal. This apparatus has two upright fixing chambers 15 and 15* (see Fig. 5), here represented as circular in cross-section. Each fixing chamber is filled with checkerwork, so built in as to leave atomizing chambers 16 and 16* in their axes. The checkerwork ends before it reaches the top of the chambers (see Fig. 1), namely, at the top of the partition which separates the fixing chambers, and above this there is a space 17 (see Fig. 6), through which the chambers are connected. The atomizing chambers 16 and 16* are continued up through the space 17 by tubes 18 and 18*, of refractory material, which extend up to the top or roof wall of the apparatus and receive at their respective upper ends atomizers 19 and 19*, to which liquid hydrocarbon is supplied by pipes 20 and 20*, respectively, and crude water gas under tension by pipes 21 and 21*, respectively; or, where for any reason gas cannot be supplied at the moment, steam may be supplied by way of branch pipes 22 and 22* (Fig. 1.)

Under perforated arches 23 and 23*, at the bottoms of the respective chambers 15 and 15*, are combustion chambers 24 and 24*, with fire boxes 25 and 25* below them. The conduit 12 (see Fig. 3) connects the generator with the chamber 24, and the conduit 12* connects the generator with the chamber 24*. Outlet conduits 26 and 26*, for the gas, lead the latter from the lower part of the respective fixing chambers 15 and 15*, to the usual seals 27 and 27*, from whence it flows for storage

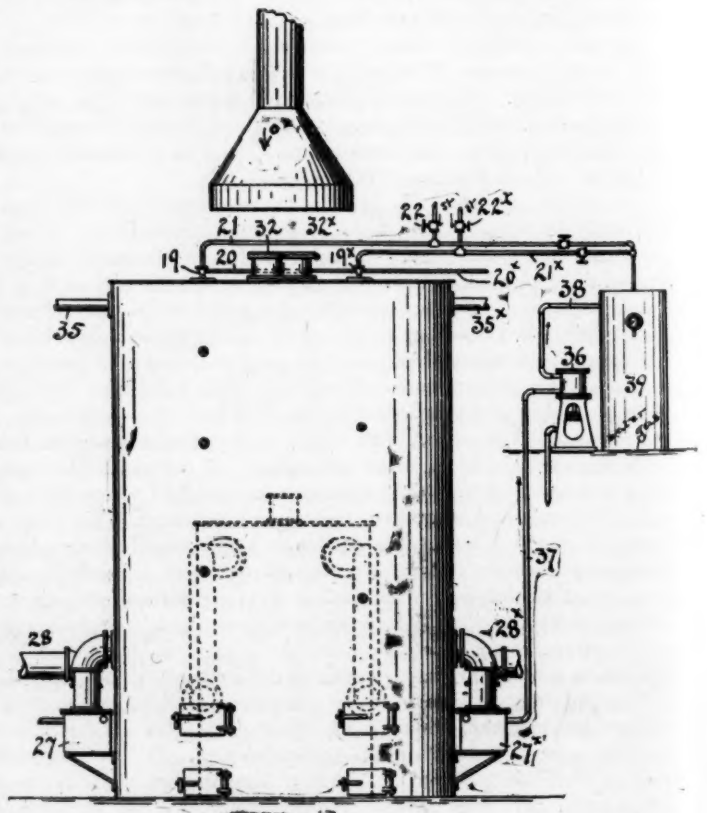

FIG. 2.

and use by way of the respective pipes 28 and 28*. Flues 29 and 29* lead from the respective chambers 24 and 24* (Fig. 3), up through the wall to the top of the same and then connect by branches 30 and 30* (see Fig. 7) with the upper ends of the respective atomizing chambers.

Flues 31 and 31* lead from the lower portions of the respective chambers 15 and 15* (see Fig. 4), up through the wall of the apparatus to the respective purge valves 32 and 32* (Figs. 1 and 2.)

Hot air flues 33 and 33* extend up through the walls about the re-

spective fixing chambers and terminate in parti-annular flues 34 and 34*, respectively (see Fig. 7), at the top of the apparatus. The upright flues connect at the bottom, and at intervals in their length, with the respective fixing chambers, as at 33a, and air inlet pipes 35 and 35* supply air to the curved flues 34 and 34*, respectively, and through them and the upright flues to the fixing chambers.

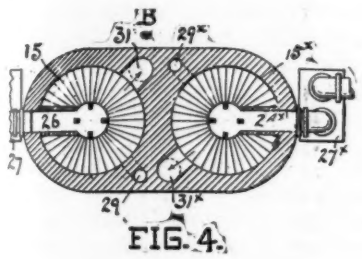

FIG. 4.

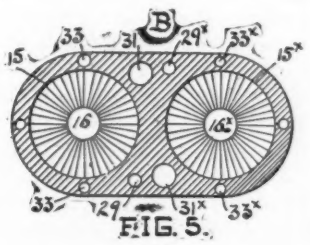

FIG. 5.

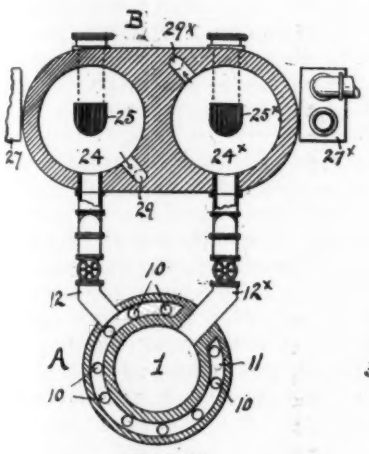

FIG. 3.

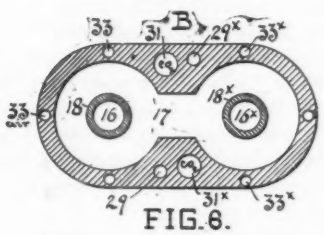

FIG. 6.

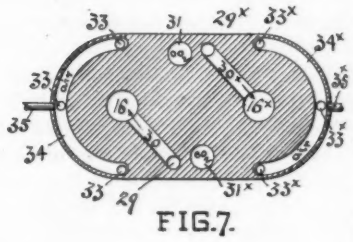

FIG. 7.

The various pipes and conduits are supplied with suitable cocks and cut-off valves as indicated in the several figures.

At the right in Fig. 2 is seen the holder for compressed crude water gas employed for atomizing the liquid hydrocarbon, and the means for compressing the gas. The compression pump 36, somewhat diagrammatically represented, receives gas from a seal by way of a supply pipe 37, and forces it through a pipe 38 into the holder 39. The atomizers are supplied from this holder. Of course the holder 39 and its pump may be placed where they will be most convenient.

The operation of the apparatus is as follows: Fire is kindled in the generator, which is then charged with fuel and the full inlet closed. The fire will be built on the grate so that the fuel ignites from beneath and the air turned on at the inlet 9 below the grate. All cocks, valves and outlets will be closed except the valve in the conduit 12*, the purge valve 32, the air inlets 35 and 35*, and the inlets for air under the fire boxes 25 and 25*. The fuel in these latter will be kept, normally, at incandescence. The products of combustion from the generator flow through the conduit 12* to the chamber 24* in the apparatus *B*, thence up through the checkerwork in chamber 15*, thence through the space 17 to the top of chamber 15, thence down through the checkerwork in this chamber to the lower extremity of the flue 31, and thence up through this flue to the open purge valve 32, whence it escapes. In its passage through the flue 31 it gives up a large part of its heat to the mass of brickwork about the chambers containing the checkerwork. Air is admitted in regulated quantities at the air inlets 35 and 35*, to aid in the combustion of the gases passing through the chambers.

When the "blowing up" has been completed, the chamber 15* and its checkerwork will be more highly heated than chamber 15 and its contents.

The next operation is to make a "run" of gas. All of the air is cut off, the valve in the conduit 12* is closed and that in conduit 12 opened. The purge valve 32 is closed and the gas outlet 28* opened. The cocks in the pipes supplying compressed water gas and liquid hydrocarbon to the atomizer 19 are opened, and the steam turned on at the inlet 6 of the generator. The steam flows down through the hot fuel in the generator, is decomposed, and the crude water gas thus generated flows up through the flues 10 to flue 11, and thence by way of the open conduit 12 to the receiving chamber 24. From this chamber the gas flows up through chamber 15, which is less highly heated than chamber 15*. In its upward flow it meets the descending hydrocarbon vapor from the atomizer 19. This vapor descends in the chamber 15 to an extent dependent on its volatility, or the temperature at which it is adapted to combine with the gas, that of lowest volatility descending lowest. Should any vapor descend into the chamber 24, the incandescent fuel of the fire 25 will subject it to the proper temperature.

The carbureted gas passes from the chamber 15 over into the chamber 15*, and down through this more highly heated chamber where it is fixed. The gas finally flows off through the passage or flue 26*, to the seal 27*, and thence out by way of the pipe 28*.

A portion of the hot gas from the generator flows up through the flues 29 and 30, to the inlet of the vaporizer 19 and mingles with the vapor of hydrocarbon.

After the run has been carried as far as desirable it is arrested and the apparatus again heated. This second blowing up operation is the reverse of the first. The fire in the generator is kindled at the top and the airblast admitted at the inlet 7. The products of combustion and gases flow up through the flues 10 to the flue 11, and thence by way of the conduit 12 to the chamber 24. Thence they flow up through chamber 15, down through chamber 15*, and up through flue 31* to the open purge valve 32*. After the chambers are heated in this way a run is made. All of the air is cut off, the valve in conduit 12 closed, the purge valve 32* closed, the gas outlet 28 opened and the pipes leading compressed gas and hydrocarbon to the atomizer 19* are opened. Steam is admitted under the grate, at 8, and also to the flue 11 at the inlet 14. The crude water gas flows through the open conduit 12* to the receiving chamber 24*, and thence up through the chamber 15*, where it mixes with hydrocarbon vapor from the vaporizer 19*. From the space or chamber 17 the gas flows down through the more highly heated chamber 15 to the passage 26, and finally passes off at the outlet 28. Some of the hot gas from the chamber 24* flows up to the vaporizer inlet by way of the flues 29* and 30*. This completes the cycle of operations and it is repeated indefinitely.

It will be noted that in the cycle of operations the "blowing up" operation is reversed, as to the flow of the gases, at each successive operation, and the "run" succeeding each blowing up is also reversed alternately. In blowing up, the gases pass first upwardly and then downwardly through the chambers 15 and 15*, and then flow upwardly to the purge valve through a flue in the brickwork. Thus their heat is utilized to the fullest extent. In making the run, the gas always passes first upwardly and then downwardly through the chambers 15 and 15*, and in a direction opposite to that of the products of combustion, thus passing through the less highly heated chamber first.

The hot water gas from the receiving chamber is drawn up through the flue 29 or 29* by the suction of the atomizer and mixes with the vapor of hydrocarbon at the atomizer, thus diffusing the vapor and thoroughly mixing it with hot gas at this point.

The fires of incandescent fuel, coke or coal, under the receiving chambers 24 and 24* serve, as stated, to supply any loss of heat at the bottoms of the combining and fixing chambers.

The fire boxes 25 and 25* will be supplied with suitable inlets, 25a, for air blasts, but these blasts should be cut off in making a run.

Over the purge valves may be placed a hood and pipe 40, to carry off the products of combustion.

The main object in supplying hot water gas to the atomizer is to increase the volume of gases and vapors entering at the tops of the chambers 16 and 16*, and cause a lateral expansion of the vapors into the interstices of the checkerwork; and the object in forming these chambers in the checkerwork is to permit of such free expansion at all points in the height of the chambers 15 and 15*.

Cathode Rays.

Some time ago M. Poincaré reported in the *Revue Generale des Sciences*, a series of investigations completed by M. Lenard, on the properties of the cathode rays in vacuum tubez. The novelty of his findings attracted the attention of the English *Electrical Review*, whose editor was moved to make the appended comment thereon:

Crookes, in his beautiful experiments with the electrical discharge in vacuum tubes, found that when the pressure was very small, the negative electrode was surrounded by a space almost completely dark. In this space, however, rays were found to exist capable of impressing photographic media, of rendering phosphorescent bodies luminous, and of producing various calorific and mechanical effects; these were the cathode rays.

The properties of these rays have been investigated by Hittorf, Goldstein, Hertz, Ebert and Wiedemann, etc., and various theories have

been proposed to explain them. Puluj, for example, imagined that they consisted of particles mechanically detatched from the electrode; but this theory was experimentally shown by Crookes to be false. The theory proposed by Crookes himself was the well-known hypothesis of radiant matter, according to which the rays consisted of molecules of the gas whose free path had been exormously extended by the rarefaction of the gas.

These recent experiments of M. Lenard, in the opinion of Poincaré, not only gave the death blow to Crookes's hypothesis, but also throw considerable doubt on the validity of the kinetic theory of gases. The fundamental idea in M. Lenard's experiments was to ascertain whether the cathode rays would propagate themselves in media different from those in which they were generated. It is well known that these rays can only be generated in highly rarefied media, and under conditions completely determined by Crookes. But once produced, the question was whether they could be propagated in a gas at ordinary pressure or in an absolute vacuum. As these rays are intercepted by glass, it appeared almost impossible that means could be devised of allowing them to pass from a gas at one pressure into one at a different pressure. This difficulty was, however, overcome by the ingenuity of M. Lenard. Taking advantage of an experiment of Hertz, in which he had shown that very thin metallic plates are transparent to the cathode rays, Lenard set about discovering a metal foil sufficiently impermeable and resistant to the air, and yet transparent to the cathode rays. A plate of aluminum from .002 to .003 mm. in thickness was found to fulfill the required conditions.

If a Geissler tube is taken, having one extremity hermetically sealed by a metal plate, with a diametral slit of 1 to 2 mm. in width, which is covered by the aluminum foil, it can soon be ascertained that the rays traverse the thin foil, and leave the Geissler tube. This result is of the first importance; the cathode rays can propagate themselves in air at the ordinary pressure, and also, it can be shown, in the same way that they can propagate themselves in an absolute vacuum. Here the hypothesis of radiant matter is entirely at fault; the experiment necessarily leads to the conclusion that the phenomenon takes place in the ether.

Many interesting questions are raised by these curious results. Why do the rays pass through the aluminium foil while they are stopped by the glass? Is it because of the difference between conductors and dielectrics? It can easily be ascertained that the thinness of the plate is the only essential condition; conductors and dielectrics behave exactly alike, provided they are of sufficient thinness.

The rays are not very distinctly visible in air or gas, especially if they are rarefied, and it is difficult to follow their path with certainty by the eye, but fortunately they can be made more visible by their action on phosphorescent substances, or their course can be determined by their photographic effect. In the apparatus of Lenard the vacuum tube was surrounded by a metallic case to screen off electric forces, and on the end opposite the aluminum covered slit a dark slide was fitted to obtain a record of the bundle of emitted rays.

The rays do not propagate themselves in a straight line; they turn round opaque bodies. This is a very important fact.

Gases, even when rarefied, are, for the rays, disturbing media. To study the propagation of the rays, M. Lenard examined the shadow thrown by a small screen of mica on a phosphorescent screen. It was soon ascertained that as the bundle of rays progressed in the disturbed medium more and more rays were deflected from the straight line. The deflected rays were partly absorbed by the gas, and the more disturbed the medium was the more absorbent it became. It was possible with the apparatus to measure the degree of permeability of different gases at different pressures. Air, for example, at 760 mm. pressure, in one experiment was penetrated to a maximum distance of 2.35 cm., at 0.019 mm. it was penetrated to a thickness of 140 cm.; hydrogen, at 760 mm., was penetrated to 10.6 cm. only, but at 0.164 mm. to 130 cm. These results show how considerable the absorption may become, and how the absorption in all gases tends to become equal at low pressures. It is possible also, by examining the luminous projection of the circular opening of a screen, to measure the degree of disturbance of the different gaseous media. The result is remarkable; if the different media are arranged in decreasing order of disturbance, they will be found to be arranged in the order of their densities. The unique property of a gaseous medium which determines the degree of its disturbance is its density. The nature of the gas is of no importance; equal masses produce equal disturbances.

Hertz was the first to observe that there exist cathode rays of different kinds which correspond to luminous rays of different colors, and which differ in their capacity for phosphorescence and absorption. The experiments of M. Lenard fully confirm this observation. The cathode rays change when the pressure of the tube producing them changes; their properties are no longer identical. For instance, the rays produced at less rarefactions are less diffused than those produced at greater rarefactions when they are afterwards propagated in the same medium.

Lastly, the very curious action of the magnet on the cathode rays is alluded to. A magnetic field, even though very weak, strongly deflects the rays. The deviation is variable with the strength of the field, but the conditions being equal, with the same field the deviation of a beam is the same in all gases and under all pressures. This important fact shows that the deviation can only be due to the magnetic deformation of the ether. It is also very remarkable that the deviation is different for different rays (produced at different degrees of rarefaction); if we suppose they are, so to speak, different colors, the magnet acts as the prism which separates and disperses the colors.

M. Hess has proposed to utilize the deflection of the cathode rays in the magnetic field to register photographically rapidly varying currents. But Poincaré considers these experiments have a still greater importance from a theoretical than from a practical point of view. He considers that Crooke's theory of radiant matter fails to explain these new phenomena, and is no longer tenable. Moreover, a serious blow is dealt at the kinetic theory of gases; this theory no longer accounts for all the facts, and the day may not be far distant when it will have to give place to other views of the constitution of gases.

What idea, then, are we to form of these cathode rays? It can be no longer doubted that the phenomenon is one which is due to the luminiferous ether. It is very remarkable that the disturbance which the molecules produce depends on their mass alone. There is nothing corresponding to this with ordinary light. Many interesting questions remain yet to be answered. Why can the rays be produced only in rarefied gas? Why under conditions so different from those under which they may be propagated? What is the state of tension of the ether inside and outside the producing apparatus? The solution of these questions will be of the greatest interest. One cannot help thinking that these questions touch the inner mechanism of luminous and electric phenomena, and it is not too much to hope that here will be found the point of view from which a better comprehension of these phenomena may be attained.

Losses in Boiler Practice and Some of their Causes.

By Mr. Daniel Ashworth, M.E.

It seems but a brief period since the highest authorities in steam and power literature made the statement that, "Covering a period of about a quarter of a century, the advance in the development of the steam engine, in its many forms and types, was marvelous and far beyond the expectations of the most impatient and exacting, and is still continuing; but, as a startling anomaly to this condition, very little, if anything, has been done toward an advance in the boiler and boiler room during that period."

Following very closely, indeed, right upon the heels of this declaration, the movement toward reform in this direction set in, resulting, at the present time, in the production of a multitude of steam boilers of various forms, all claiming, and many sustaining, a commendable advance in economy, safety and durability. The development of boilers, together with furnaces and devices, all converging to a more thorough combustion and rapid steam generation, would certainly lead one to believe that a radical improvement in the way of economy of fuel would result. While, in a measure, in special cases and conditions, there has been somewhat of an encouragement, yet a careful review constrains us to believe that the results are far short of what would be expected, and this is demonstrated, not only by careful and elaborate tests, but, in addition, by close observations of regular continuous operation. This cannot be attributed to the unworthiness of the modern boilers or appliances, for a large number possess many features and requirements to give favorable results, and exhibit, on the part of the designers, a knowledge and research in the principles for generating steam which exhibit commendable ingenuity and skill. Now, the question which presents itself to us so forcibly is, why, in the face of all these favorable movements, does the boiler department fail to keep pace in its results with the thoughts and productions of boiler, furnace and stoker builders? Observations of a number of boiler rooms applied to a variety of purposes enable us to note that it is the aggregate of the small losses that so greatly neutralizes and sets at naught the best efforts in this direction. It is no uncommon thing to come in contact with a steam plant of modern equipment where cracked furnace walls are presented at numerous points, permitting a large amount of cold air to

enter, thus entailing a loss of a most wasteful character. In the return tubular boilers we are confronted with the gross indifference shown in many places by the fouling of tubes. The amount of deposit of carbon or soot that is frequently permitted to accumulate would scarcely be believed when it is so well known that the deposit is one of the greatest non-conductors of heat, and hence another entailer of loss. In the water tube boilers we have the same trouble, but in a different way, viz., the gross neglect in not keeping the tubes clear of scale and other deposit, many cases being presented where the tubes are almost completely obstructed. Even what is looked upon as comparatively light scale is well known to be greatly detrimental to boiler efficiency.

Again, we have in the majority of steam plants a lack of capacity. In some cases this is the result of guess work or lack of knowledge as to the amount of steam required for the view. Occasionally it is a result of a mistaken economy in first cost, and frequently where additional work has been added to an establishment without a corresponding increase in the boiler plant. How often do we hear this query, "Why am I short of steam? These boilers, five years ago, operated this establishment without a bit of trouble and with perfect ease, and now we can scarcely operate without a source of annoyance caused by dragging along, etc. There certainly must be something wrong with these boilers, for they ought to do just as well now as they did then. We have tried all manner of engineers and we have tried all qualities of coal, and we seem to have exhausted all our resources, and instead of matters improving, the trouble has been increasing all the while." After some reflection we very quietly ask, "Have you made any changes in your plant as regards work done, or to put it more plainly, have you increased your establishment any within that time?" "Oh my, yes. Why, we have put on another story, and we have built that wing out there since then." And, being conducted through the establishment, we are shown, with considerable pride, where a large fan had been put in, and a pulverizing machine and a large boring machine. Then we are taken into another department and shown where they have added an electric light plant, and in addition to this they have a series of steam blasts or baths where electroplating and such are done, where live steam is called into requisition very often and in considerable quantities. Besides that, they have, in keeping with the age in which they live, added a couple of electric motors for driving electric cranes, and put in a couple of elevators, and so on. And there seems to be somewhat of a thoughtful expression upon the features when we ask, "Has it occurred to you that, with all these additions and this gratifying progress, you have done nothing towards increasing your boiler power? We venture to say that if you were to remove all these additions that you have made in the period you speak of, setting aside the usual wear and tear, those boilers would perform their functions just as easily as they did when they were first placed." This source, overtaxing boiler capacity, is so easily overlooked that the number of cases is somewhat startling. This undue urging of boilers, produced by the causes enumerated, always has its accompaniment of wear and tear, destruction of the furnaces, high stack temperature of escaping gases, in which the heat units are rapidly forced up the stack, or in brief, a waste of fuel beyond comprehension.

In power plants connected with the city buildings, we are confronted on almost every hand with the utter lack of space and every condition that would be conducive to anything approaching proper results. This crying evil is brought about either by lack of appreciation of the importance of the steam plant as to results, or total indifference upon the part of those who have the designing and planning of the buildings. The prevailing idea seems to be to concentrate upon proper proportions in all parts connected with the building, and at the very last moment to conceive the idea that any hole or place that is left is good enough for the engineering department. From this standpoint we have boilers placed in the most inaccessible places, wretchedly cramped, with tortuous flues to reach what is known as the stacks for the boiler, which are, in many buildings, simply flues with capacity sufficient for the ordinary grates in an office. No provision is made for ventilation; in fact, nothing that tends to give the least efficiency. And these are not, by any means, in shabby buildings or obscure places, but are very frequently met in the most prominent and otherwise well-appointed buildings.

Happily we are encouraged in the belief that this is passing away. It will, however, linger with us until that time shall come when the architect relinquishes the idea that he knows all about steam plants and engineering. The revival of mechanical stokers, which had been lying dormant on the other side of the ocean for a number of years, resulting in the development of a number of machines, each possessing its respective merits, not only with the machine itself, but in the type of furnaces that formed a part of the same. But, taken as a whole, the expectations of the most earnest advocates of these machines have not been realized, and the inherent weakness or defect which presents itself in the greater number of these machines is the large amount of incandescent fuel that is dropped in the ash-pit during the process of dumping the bars, which is necessary at frequent intervals. This entails not only a loss of the very best fuel in the condition to produce the best results, but also wastes in this critical operation a large volume of heat that should be retained and distributed to do effective work. The most earnest advocates of mechanical stokers recognize this, and it has become a matter of serious thought in considering this loss whether we are really better off than with first-class hand firing, or with a shaking grate. The most pertinent question, and that which seems to me the most valuable and most likely to spur us on to measures looking to the removal of these features that are so detrimental is, "How can we remove this existing state of affairs?" And then, when these are removed, it would be eminently proper to consider the finer and more technical points which would be required to sustain still further advances. One of the prominent features, and it seems to me to be the key of the whole situation, is that, in the first place, the superintendent of the boiler or the power department should recognize that the boiler room is the threshold of economy and efficiency, and whatever losses are sustained here, by any means, are irrevocable in the future stages of the power operation, and it would seem that, at this stage, the losses must easily occur, and, at the same time, it cannot be denied that, with proper interest in the management of the various details, they are just as easily prevented. I trust that the time is rapidly passing away when the superintendent will look upon the fire room as simply a place to shovel the coal under the boilers, pump in the water, and remove the refuse from the grate bars. Besides shoveling coal, carrying the water—and, by the way, in nine cases out of ten, this feature is not properly done—there should be a system of cleaning tubes, internally and externally. Thorough vigilance upon the walls of the boiler, attention to the matter of draft, and proper distribution of the fires, would certainly bring about a higher degree of efficiency and economy. In addition to these advances in the grade of firemen, there must be a more liberal idea as to the capacity required in steam boilers to do their work.

Red Lead Paint for Iron.

Mr. Ralph K. Wing, in a recent communication to *Architecture and Building*, writes:

Under the caption "Reasons and Remedies for Rust in Skeleton Structures," in a recent issue of your publication, appears some allusion to red lead as a protective paint likely to cause misapprehension. Your contributor treats of "red lead in oil," remarking, "I do not hesitate to say that there are not only one or two, but many concerns in this country whose red lead in oil is in every respect equal, and probably even superior, to that of 50 years ago. It is as nearly chemically pure as a commercial article possibly can be." This observation is certainly correct as it applies to the product of the actual manufacturers of dry red lead—the pigment. I would contend, however, as one having had some experience both in the production and consumption of red lead, that mixtures of pure red lead and pure linseed oil alone, by virtue of their chemically combining, the resultant being a virtual cement and the most resisting paint coating known, is not and cannot be furnished as a mixed paint "as chemically pure as a commercial article can be." All cements must be applied as soon as possible after being combined, that the hardening or initial set shall take place on the surface desired to be protected and not in the mixture. Hence the dry red lead must be mixed with oil as wanted for use.

Your corresponent expatiates on the action of electrical currents on paints applied to conductors. He says, "The question is now whether metallic paints, especially red lead, offer a protection against electrical influences." To support his argument that they do not he quotes the theory of metallic action inaugurated by the process of rusting from a paper by Mr. Wm. Thompson before the Manchester (England) Society of Engineers, entitled "The Influence of Some Chemical Agents in Producing Injury to Iron, etc." Mr. Thompson's thesis, however, deals largely with the protection afforded iron by paint, his conclusions being that red lead is decidedly the best for the purpose. The following is an excerpt from a resumé of this paper in the *London Engineer* of December 1, 1893:

"From experiments he had made with different paints and varnishes he had found red lead paint to be the best coating to prevent iron from rusting. This he had thought a remarkable result, because red lead

was a highly oxidizing body, but the reason was found to be that the red lead had the effect of producing a skin of the unoxidizable and protective black or magnetic oxide on the iron itself under the paint. He had some time ago made a large number of experiments to determine which paint was the most suitable for protecting a large iron structure from the action of sea water, spray and the rain, and he had arrived at the conclusion that red lead was the best."

It would seem, then, from Mr. Thompson's able paper that the leading engineers and architects, in uniting on red lead, are quite right in desiring a pigment that is not inert, but chemically unites with the oil.

Red lead is referred to by your contributor as "metallic paint," and as "lead rust." I believe that universally among painters the term "metallic paint" is used to distinguish "iron rust" or iron oxide alone. Red lead, it is true, is "lead rust," but it is the final,the ultimate oxide of lead, practically unaffected by atmospheric temperatures and conditions. Iron oxides, on the contrary, are virtually all capable of further disintegrating oxidation, instituting like action on all iron or steel surfaces with which they are brought in contact. The oxides of lead and the oxides of iron no more similarly act or are acted upon, though both oxides, than oil and water, though both liquids.

The producers of red lead are not aware that they are confined to antiquities or previous generations to furnish examples of the superior protective powers of red lead. This pigment is being used more than it ever was before. It is subjected to all the various trying conditions present in our modern structures. How important this question of attaining a suitable covering for iron in the skeleton structures now being so generally put up in our cities is was shown by the discussion which took place in New York at the last convention of the American Institute of Architects. The freely expressed fear thal some of these gentlemen manifested was largely due to the liability of these structures to rust. In other words, their life depended on the time during which they could be protected, and we are free to acknowledge that the question of time must enter into the consideration of every paint. Durability of the paint and its extended protective powers is the court of last resort. A paint that will link the good old times with the present by records of continuous unbroken service is red lead. Its being called for in the specifications of the principal municipalities in this country having extensive bridges, its being in use in almost all of the great navies of the world, our own included, to say nothing of the iron and steel hulls of the merchant marine, irrespective of nationality, and its being designated on the metal construction of over 25 leading trunk railway lines in the United States, is eloquent evidence that red lead is supreme at the present writing.

Lennard's Continuous Tar Still.

An English authority thus describes the Lennard new apparatus for the continuous distillation of tar :

Many attempts have been made for years past to distill tar continuously, but the great difficulties met with have not hitherto been successfully overcome. Now, however, Mr. F. Lennard, of the firm of Forbes, Abbot & Lennard, has produced an apparatus which is absolutely constant in action, and which successfully and economically accomplishes the separation of the desired products. The still in question is capable of treating from 15,000 to 20,000 gallons of tar per 24 hours, and has been at work for the past 12 months, during which time about 4,000,000 gallons of tar have been passed through it. The firm with which Mr. Lennard is connected is now erecting a second continuous still to treat 35,000 gallons per 24 hours. When completed the whole of the tar obtainable by this firm in London will be distilled in these two apparatus.

The principle of the still depends on subjecting the tar to a minimum of heat,which is best effected by exposing a small quantity of tar to the largest area of heating surface at a minimum temperature, consistent with obtaining all the products sought for in the process of distillation.

The object to be thus attained is effected by passing the tar through a series of coils heated by means of a large area of hot brickwork. To economize the heat, the furnace gases, after rendering the brickwork incandescent, are diverted back again over the protected coil, and finally, when the heat of the gases is well spent, they are allowed to play over the naked coil, when they meet the incoming tar, which robs them of the last traces of useful heat. The tar is in this way heated up to the requisite temperature to permit of the anthracene and lower fractions being distilled, and it is then delivered into a specially designed scrubber, in descending which it meets with a current of dry (not superheated) steam. The tar being here spread over a very large surface in a thin film and in contact with steam is entirely and rapidly denuded of the desired volatile compounds. It may here be remarked that, owing to the tar being so finely divided, it yields separation at a much lower temperature than is the case with the ordinary system of distillation, where considerable depths of tar are operated upon.

The tar, after being denuded of its volatile constituents, resolves itself into hard pitch, which collects in a chamber at the bottom of the scrubber, where, to render it merchantable, it is mixed automatically with suitable oils to bring it back to the requisite softening point, after which it flows off at a low temperature into the pitch bed.

Following now the path of the gaseous compounds, these are passed through a series of condensers, each of which brings down during the passage of the gases the various fractions required. The condensation in these is effected by the crude tar flowing around the coils of the condenser, by means of which the gaseous compounds are condensed, and at the same time the crude tar is heated to such a temperature as to permit of the light oils and ammoniacal compounds being given off, to separate which the tar is passed through a simple scrubber, meeting a current of steam in its descent. It is this dehydrated tar which has been previously referred to as passing through the heating coils of the still on its way to the first scrubber.

It will be plainly seen from this description that almost the whole of the heat expended in heating the tar for distillation is recovered, and that the waste gases always pass off to the chimney at a very low temperature, with the result that great economy of fuel is effected.

By means of such an apparatus, which occupies but a small space, it is stated that a quantity of tar from 20,000 to 35,000 gallons can be distilled in 24 hours. The apparatus being practically automatic, the labor is reduced to a minimum ; one man is capable of attending to a still of the above mentioned capacity. Indeed, there appears to be no reason why the same labor should not be able to control a still dealing with double the quantity. The wear and tear would also appear to be reduced to a minimum, as the temperature is nowhere excessive, and is absolutely constant. In proof of this it may be mentioned that a portion of the heating coil, on being examined after several million gallons of tar had been passed through it, was said to be absolutely unaffected. This being the only point at which anything approaching high temperatures are used, the rest of the apparatus is also necessarily unaffected. The possibility of the coil becoming choked in dealing with a highly carbonaceous tar might appear likely to cause difficulty, but it is stated that owing to the fact that the tar is always in motion, and that distillation does not take place in the coils, carbonization is entirely prevented. In fact, the heat to which the tar is subjected is never sufficient to permit of carbonization or of destructive distillation occurring.

The advance made by this system over the older intermittent system of distillation is great, both from the economic and the scientific point of view, and equally so from the sanitation aspect. Here no tar is exposed from the time of its being pumped from the storage well to its ultimate recovery again in the form of distillates in the storage tanks provided for them; all circulation takes place in an absolutely tight apparatus. There is no displacement of foul gases from filling-up vessels, no boiling over of stills, no running off of large quantities of pitch at a high temperature, and absolutely none of the dirt and smell which invariably accompany the older method of distillation. The complete dehydration of the tar before distillation and the absence of any destructive distillation have a marked effect upon the character and volume of the permanent gases evolved. Those given off from a still treating 20,000 gallons of tar per 24 hours are easily carried to the furnace through a ⅜-inch pipe.

I am not in a position to criticise this system from a distiller's point of view, but as an inspector I cannot speak too highly of it. It is undoubtedly a great advance in the right direction.

Coal in Peru.

In an interesting communication to Mr. John Birkinbine, from M. V. de S. Pazos, C.E., of Pachucaca, Peru, the latter gave the following details respecting the coal fields of Peru :

Coal occurs to my personal knowledge in Peru in the departmentos of Pemo Cuzco, Junin, Aucash, Cajamarca, and the southern part of Piura. There is no Andean province of these departmentos which does not possess a coal seam. The coals from Junin up to Cajamarca, a distance of over 300 leagues (over 1,000 miles) are either Cretacerus or Jurasic. No true carboniferous coal occurs in these departmentos ; but although these coals may be called lignites, geologically speaking, they present every variety, from the true graphite up to the pitch tar which softens under the heat of the sun. In the province of Cajatarnbo, departmento de Aucash, I remember having seen on a road less than 3

leagues long (taken in a perpendicular distance from west to east), from the true graphite, as good as any in the world, up to the true bituminous coal, whose coke was used in a smelting furnace. The width of the graphite was 20 centimeters, that of the coking coal was over 2 meters. The coal from Puno, according to Mr. Raimondi, is a true carboniferous coal. I have never been in this departmento, but have seen samples of good coal from outcrops of a seam that shows itself in one of the islands of Lake Titicaca.

In Junin some of the seams are found between limestone walls; in other places they occur between sandstone walls. All these seams are always found in the thick limestone which forms the top of the Andes at an altitude from 10,000 to 16,000 feet above the sea, and are generally in eastern slopes of this Cordillera. At Huari there is a seam of carbonaceous matter which softens with the heat of the sun. In Chacapalpa the seams, about 80 to 100 centimeters, are found in limestone walls, and the coal is so light and gaseous that sometimes it explodes on being fed into the stoves. At Llaxacocha there is a seam of about 2 meters which contains vanaduin and traces of platinum. This coal is exceedingly black, crumbles under the slightest pressure, in the assay furnace burns bright and very much like charcoal, and contains 93 per cent. of fixed carbon, about 4 per cent. volatile matter, and 3 per cent. ashes. In Hatunhuasi there is a seam of about 5 meters and 5 leagues in extent. This coal gives about 40 per cent. of pretty fair coke, on which is ran the smelting furnace of Ganly, and although the Casapalca smelter is only 20 miles away, they consume there principally English coke which costs the Company 45 Peruvian dollars a ton. The use of English coke on the top of our cordilleras shows how difficult must be the transport of our home product. The Casapalca smelter is at a distance of about 25 leagues from the Hatunguasi fields, and about 32 leagues from Callao, our seaport; but there is rail communication with the sea, while the Hatunguasi coke has to be transported on "Mama" back.

In Cerro de Pasco, our principal mining center, there are seams of fat and dry coal which is used for cooking and all the uses to which coal can be put. The mineral railway, which has an extent of about 3 leagues, is as far as all know the only railway in Peru which runs with Peruvian coal. Besides the seams of coal in this province, there is an oily shale which is used in the Humarranca smelter for assaying and cupeling purposes. This shale burns with a long flame, and very active combustion and cupelation by the English method are done here without an artificial blast. This shale is of a bluish color before burning and white after it is burnt.

In the "Callejon de Huaylas," a valley in the heart of the Andes excavated by glacial action down to 8,000 feet, and whose eastern wall is a cordillera whose highest peaks rise about 24,000 feet; as many as 7 different seams of coal have been found.

The coal of this region seems to be of Jurasic origin. The two lower seams cannot be burnt in grates, for they clinker to such an extent that the air cannot pass through the clinkers being fusible silicates of copper and lime. The middle seams, which are from 3 to 6 meters in width, give a fuel in all respects similar to the Pennsylvania anthracite, while the upper ones, which are from 1 to 3 meters, give a crumbly porous dry coal. The formations here are very much distorted and the seams full of faults. There is a place near the town of Caraz, where the upheaved rock has made a K against the upheaving rock. Until recently the only persons who made use of this coal were the blacksmiths who used to go to the nearest outcrop of the town and wedge down enough coal to last them for a week. At present the coal is beginning to be used for cooking and metallurgical purposes.

In Hualgayoc, another mining center of Peru, coal is, or was used for smelting copper ores; the two smelters there, which I believe have shut down, drew their coal from two Cretaceous seams of about 2 and 1.50 meters respectively. The nearer seam gave a coal of long flame and about 30 per cent. of ash, and it seems to me it was more a bituminous slate than a coal. This fuel was used for roasting. The farther seam gave good coke, which was used in the shaft furnaces.

This is the most northern point where coal was used, but the same coal formation continues up to the Departments of Puira, which form the boundary line between Peru and Ecuador. If there is any coal being used in Puira, or the coal-bearing strata is present there, I don't know.

Summing up the coal-bearing districts of Peru we find that the heart of the country or the top of the Andes is all a coal-bearing region, and that this fuel is known to exist and more or less worked throughout the Peruvian Andes, with the exception of the gap left by the Departmentos of Ayacucho and Huancavelica, where, at least as far as I know, this fuel has not been found.

Within the last six years coal prospecting received an impetus on account of the lead smelters that sprang up all through the country. Most of these smelters have been a failure, but whatever may have been the causes of their failing, certainly it has not been the lack of adequate coal. Still the two largest and most successful smelters, situated on our principal railways, receive the largest part of their coke from England, while their roasting is done principally with "taquia" (the excrement of llamas).

Perhaps the true secret of the failure of so many smelting plants is the want of good roads for a steady supply of ore and fuel, united, in most cases, with a lack of true technical knowledge.

The Departementos of Junin, especially "Cerro de Fascoh," is the only place where Peruvian coal is given the many and varied uses to which coal is applied, and even here the consumption is very small, as fuel is very little used as a mechanical power, most of the power being obtained from water falls.

The mining is very rude; when coal is wanted the seam is began to be worked from the outcrop, the workings are carried on the seam until they cave in, when it is abandoned and another working started. Although in some rare instances the coal mines are worked with a little more care and regularity and small tunnels driven to drain the mines, coal mining receives a very secondary consideration, since the amount of fuel consumed is so small.

Peruvian coal is produced and consumed in the Andean region of the country, all the coal used in the Pacific coast comes principally from England and some from Chile, while our few trans-Andean settlements and our vessels in the Amazon river use charcoal or wood.

There is really neither coal nor iron industry in Peru. The causes for this lamentable state of things are various: 1st. The topography of the country. 2d. The absence of roads. 3d. The ignorance of our statesmen, who after having finished their Lima education go to Paris to amplify it, and remain ignorant of the wants and resources of the country, and returned afterwards filled with free trade ideas, more to plan out commercial schemes than to develop the country by a systematic opening of its resources. 4th. The constant civil struggles which have retarded the growth of the country and in which one ambitious soldier has succeeded another to rule its destinies. These ambitious soldiers have really been so "unambitious" that they have never tried to have swords of their own, but have remained satisfied with paying the European ironmaster a tribute in the form of silver by which they were allowed to carry their arms.

These are the true causes of the sad state of our industries. There are still untouched our iron veins and coal fields, representing an amount of real wealth and prosperity which no man can approximate, and I still hope in Providence to live long enough to see the virgin soil of Peru turned by shovels and plowshares made of Peruvian iron.

The Magnetic Properties of Liquid Oxygen.

The gist of the original references, by Prof. James Dewar, F.R.S., to the magnetic properties of liquid oxygen, in an address delivered by him before the Royal Institution of Great Britain, are well worthy of renewed attention at the present time in view of the current developments respecting this subject. After alluding to the generous aid which he had received, both from the Royal Institution and from others, in connection with his researches on the properties of liquid oxygen, and to the untiring assistance rendered him by his co-workers in the laboratory, Prof. Dewar said that on the occasion of the commemoration of the centenary of the birth of Michael Faraday he had demonstrated some of the properties of liquid oxygen. He hoped that evening to go several steps further, and to show liquid air, and to render visible some of its more extraordinary properties.

The apparatus employed consisted of the gas engine down stairs, which was driving two compressors. The chamber containing the oxygen to be liquefied was surrounded by two circuits, one traversed by ethylene, the other by nitrous oxide. Some liquid ethylene was admitted to the chamber belonging to its circuit and there evaporated. It was then returned to the compressor as gas and liquefied, and thence again into the compressor as required. A similar cycle of operations was carried out with the nitrous oxide. There was a hundredweight of liquid ethylene prepared for the experiment. Ethylene was obtained from alcohol by the action of strong sulphuric acid. Its manufacture was exceedingly difficult, because dangerous, and as the efficiency of the process only amounted to 15 or 20 per cent., the preparation of a hundredweight of liquid was no light task. The cycle of operations, which, for want of time, was not fully explained, was the same as that commonly employed in refrigerating machinery working with ether or ammonia.

The lecturer then exhibited to the audience a pint of liquid oxygen, which by its cloudy appearance showed that it contained traces of impurity. The oxygen was filtered, and then appeared as a clear transparent liquid with a slightly blue tinge. The density of oxygen gas at —182° C. is normal, and the latent heat of volatilization of the liquid is about 80 units. The capillarity of liquid oxygen at its boiling point was about one-sixth that of water. The temperature of liquid oxygen at atmospheric pressure, determined by the specific heat method, using platinum and silver, was —180° C.

Reference was then made to a remarkable experimental corroboration of the correctness for exceedingly low temperatures of Lord Kelvin and Prof. Tait's thermo-electric diagram. If the lines of copper and platinum were prolonged in the direction of negative temperature, they would intersect at —95° C. Similarly, the copper and palladium lines would cut one another at —170° C. Now, if this diagram were correct, the electromotive force of the thermo-electric junctions of these two pairs of metals should reverse at these point. A Cu—Pt junction connected to a reflecting galvanometer was then placed in oxygen vapor and cooled down. At —100° C. the spot of light stopped and reversed. A Cu—Pd junction was afterwards placed in a tube containing liquid oxygen, and a similar reversal took place at about —170° C.

Liquid oxygen is a non-conductor of electricity; a spark taken from an induction coil, 1 millimeter long in the liquid, requires a potential equal to a striking distance in air of 25 millimeters. It gave a flash now and then, when a bubble of the oxygen vapor in the boiling liquid came between the terminals. Thus liquid oxygen is a high insulator. When the spark is taken from a Wimshurst machine the oxygen appears to allow the passage of a discharge to take place with much greater ease. The spectrum of the spark taken in the liquid is a continuous one, showing all the absorption bands.

As to its absorption spectrum, the lines A and B of the solar spectrum are due to oxygen and they came out strongly when the liquid was interposed in the path of the rays from the electric lamp. Both the liquid and the highly compressed gas show a series of five absorption bands, situated respectively in the orange, yellow, green and blue of the spectrum.

Experiments prove that gaseous and liquid oxygen have substantially the same absorption spectra. This is a very noteworthy conclusion, considering that no compound of oxygen, so far as is known, gives the absorptions of oxygen. The persistency of the absorption through the stages of gaseous condensation towards complete liquidity implies a persistency of molecular constitution which we should hardly have expected. The absorptions of the class to which A and B belong must be those most easily assumed by the diatomic molecules (O_2) of ordinary oxygen; whereas the diffuse bands above referred to, seeing they have intensities proportioned to the square of the density of the gas, must depend on a change produced by compression. This may be brought about in two ways, either by the formation of more complex molecules or by the constraint to which the molecules are subjected during their encounters with one another.

When the evaporation of liquid oxygen is accelerated by the action of a high expansion pump and an open test tube is inserted into it, the tube begins to fill up with liquid atmospheric air, produced at the ordinary barometric pressure.

Dr. Janssen had recently been making prolonged and careful experiments on Mount Blanc, and he found that these oxygen lines disappeared more and more from the solar spectrum as he reached higher altitudes. The lines at all elevations come out more strongly when the sun is low, because the rays then have to traverse greater thicknesses of the earth's atmosphere.

Michael Faraday's experiments made in 1849 on the action of magnetism on gases opened up a new field of investigation. The following table in which + means "magnetic" and — means "negative," summarizes the results of Faraday's experiments:

Magnetic Relations of Gases (Faraday).

	In Air.	In Carbonic Acid.	In Hydrogen.	In Coal Gas.
Air	0	+	+ weak.	+
Nitrogen	—	—	— strong.	—
Oxygen	+	+	+ strong.	+ strong.
Carbonic acid	....	0	—	— weak.
Carbonic oxide	—	—	—	— weak.
Nitric oxide	—weak.	+	+	....
Ethylene	—	—	—	— weak.
Ammonia	—	—	—	.
Hydrochloric acid	—	—	— weak.	....

Becquerel was before Faraday in experimenting upon this subject. Becquerel allowed charcoal to absorb gases, and then examined the properties of such charcoal in the magnetic field. He thus discovered the magnetic properties of oxygen to be strong, even in relation to a solution of ferrous chloride, as set forth in the following table:

Specific Magnetism, equal weights (Becquerel).

Iron	+	1,000,000
Oxygen	+	377
Ferrous chloride solution, sp. gr. 1.4334	+	140
Air	+	88
Water	—	3

The lecturer took a cup made of rock salt and put in it some liquid oxygen. The liquid did not wet rock salt, but remained in a spheroidal state. The cup and its contents were placed between and a little below the poles of the electro-magnet. Whenever the circuit was completed the liquid oxygen rose from the cup and connected the two poles. Then it boiled away, sometimes more on one pole than the other, and when the circuit was broken it fell off the pole in drops back into the cup. He also showed that the magnet would draw up liquid oxygen out of a tube. A test-tube containing liquid oxygen when placed in the Hughes balance produced no disturbing effect. The magnetic moment of liquid oxygen is about 1,000, when the magnetic moment of iron is taken as 1,000,000. On cooling, some bodies increased in magnetic power. Cotton wool, moistened with liquid oxygen, was strongly attracted by the magnet and the liquid oxygen was actually sucked out of it on to the poles. A crystal of ferrous sulphate, similarly cooled, stuck to one of the poles.

The lecturer remarked that flourine is so much like oxygen in its properties that he ventured to predict that it will turn out to be a magnetic gas.

Nitrogen liquefies at a lower temperature than oxygen, and one would expect the oxygen to come down before the nitrogen when air is liquefied, as stated in some text books, but unfortunately it is not true. They liquefy together. In evaporating, however, the nitrogen boils off before the oxygen. He poured two or three ounces of liquid air into a test tube, and a smouldering splinter of wood dipped into the mouth of the tube was not re-ignited; the bulk of the nitrogen was nearly five minutes in boiling off, after which a smouldering splinter dipped into the mouth of the test tube burst into flame.

Between the poles of the magnet all the liquefied air went to the poles; there was no separation of the oxygen and nitrogen. Liquid air has the same high insulating power as liquid oxygen. The phenomena presented by liquefied gases present an unlimited field for investigation. At —200° C. the molecules of oxygen had only one-half of their ordinary velocity and had lost three fourths of their energy. At such low temperatures they seemed to be drawing near what might be called the "death of matter," so far as chemical action was concerned; liquid oxygen, for instance, had no action upon a piece of phosphorus and potassium or sodium dropped into it; and once he thought, and publicly stated, that at such temperatures all chemical action ceased. That statement required some qualification, because a photographic plate placed in liquid oxygen could be acted upon by radiant energy, and at a temperature of —200° C. was still sensitive to light.

Professor McKendrick had tried the offect of these low temperatures upon the spores of microbic organisms, by submitting in sealed glass tubes blood, milk, flesh and such like substances for one hour to a temperature of 182° C., and subsequently keeping them at blood heat for some days. The tubes on being opened were all putrid. Seeds also withstood the action of a similar amount of cold.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, Dec. 10, 1894.

The Floods.—The Respective Liabilities of Gas and Electricity Suppliers.—Gas Fires for Hotel Bedrooms.

The middle portions of the month of November will be marked as an epoch in many parts of this country by reason of the heavy floods that have prevailed. A series of unusually severe rains, following closely one on the other, resulted in catastrophes and disasters that have certainly not been equalled in the present century. The operations of one of our large railway companies were completely crippled for several days by landslips and submergencies, not in one place only, but in some seven or eight parts of its district. There was more than one actual washing away of the road for some considerable length, and the entire cost for repairs has been put at not under £100,000 to this concern alone. The general injury to property has been very serious, and gas companies have not escaped the devastation. A large portion of the city of Bath and adjacent neighborhood was for several days in a condition that

fully justified the title of this ancient Roman settlement, a depth of 8 feet of water being attained in some of the streets. The supply of gas, and also that of electricity, was completely stopped for three or four days, the whole area of the gas works being flooded to a depth that necessitated the suspension of operations unavoidable, and there was nothing to do but to wait till the water went down. A similar state of things prevailed at the royal city of Windsor, where it soon became necessary to announce an indefinite suspension of the gas supply. The railway stations were lighted by flaring naphtha lamps, carriage lamps, etc., for the time, and the appearance of the submerged districts at night was dismal in the extreme. Many gas works were overflowed to an extent sufficient to extinguish the retort house fires, for a few hours, and in more numerous instances, low-lying districts were put in darkness by the flooding of the main pipes. In one instance the flood, gradually rising, floated a large gas meter up and wrenched off the connections. The water instantly entered the broken service and flooded a quarter mile or so of main. Fortunately in this climate these floods are so rare that there is no occasion to make provision against them, but it is worth noticing that underground connecting pipes were frequently a source of trouble. The liquor and tar wells were filled by the water, and then the fluid returned up the pipes from the overflow seals, and flooded the condenser or scrubber connections, thus effectually stopping the manufacture of gas.

The past month has also been characterized by two instructive contributions towards the important subject of the relations between, and the respective responsibilities of, the gas companies and electric companies when working together in the same district. In this, as in some other matters, the electricians have endeavored to make capital at the expense of gas, and to take advantage of the forbearance of gas suppliers. Only lately they have labored the item of unaccounted-for gas so heavily, that the ordinary public might be excused for imagining that the whole of the soil beneath their feet is permeated by explosive mixtures of gas and air, and that a gas explosion on a grand scale, sufficient to completely wreck a street or district, is quite within the bounds of possibility. Such extravagance of assertion or insinuation is best answered by the silent testimony of actual everyday practice. Excavations of all kinds are continually being carried on in all parts of our large towns, and so far from it being a common thing to tap a vein of explosive gas, it rarely happens that escapes or leakages are discovered by this means. There may be circumstances under which a gas company is justly liable for the consequences of explosions of gas in their district, but no one can prove them to be responsible for the effects of an exterior agent, such as electricity, water, or undue exposure or underpinning of their mains and services. It goes without saying that at the worst they cannot do more than allow the gas to escape, and that the only danger to be feared is that of explosion or conflagration. The risk of poisoning is so remote as not to be worth considering. Electricity is known to be liable to attack and corrode or perforate gas pipes, thus leading to serious gas escapes, but there is no such aggresive action on the part of gas. The first item to which I would direct attention is a paper read by Mr. S. W. Durkin, of Southampton, at a recent meeting of the Southern District Association of Gas Managers, entitled "How an Electric Current Introduced Gas into an Electric Culvert."[1] He describes how an electric culvert had been laid under a sidewalk in a busy thoroughfare, just above the level of the gas service pipes laid from the main to the various premises of the customers. The services were embedded in the lower part of the structure, and insulated by half-round stoneware tiles. A line of cable sagged till it touched one of these so-called insulators which happened to project a little into the interior of the culvert, and possibly by some means was abraded at this point. However that may be, a flow of electricity through the insulator to the service was established, perforating the tile, and also the gas pipe, with an irregular hole of some ¾ square inch area, through which a bountiful (gratis) supply of gas passed into the culvert. This action was discovered in time to prevent a repetition of the famous Tottenham Court Road explosion, but it is needless to add that the risk was great. The moral of this incident seems to be that where an electric culvert is laid under the sidewalk it should be below and not above the line of services, and that the latter should be clear of the outside of the culvert. As gas men know well, it is impossible to lower the services without practically relaying the whole system, and as usually laid it is tight work to put even a shallow culvert above them.

In view of the fact that an escape of gas cannot in any way cause a leakage of electricity, it is obvious that gas companies can in no way be blamed for, or identified with, injuries caused by electric shocks or other evidence of escaping electricity. But attempts are being made to identify them with explosions caused by electricity. If two urchins cause a gun-powder explosion, it is probable that one lays the train and the other puts the match. And this represents the position selected for the gas companies by their electrical friends. So far, they are to be congratulated on their ingenuity, for if an explosion occurs in an important thoroughfare, thickly laid with services or mains, it is difficult to prove that gas did not escape from some part of the system. There are many situations where it would be simply impossible to strip every main and every service, which is the only way of positively proving the absolute soundness of the same. Further, it is scarcely possible to render gas companies liable for the obscure and pernicious influences known as electrolysis. So a suggestion of this sort coupled with an ingenious reference to the unaccounted-for gas item, is a specious sort of argument that is easily made. While it is difficult to positively uphold it, there is equal difficulty in positive disproof.

These reflections are suggested, not only by Mr. Durkin's paper, but also by a perusal of the evidence laid before a government inspector, with a view of eliciting the cause or causes of an accident occasioned by electricity in a crowded London thoroughfare a few weeks ago. The effects were somewhat alarming. A horse was struck dead, several persons received shocks sufficient to produce hysteria, paralysis of the muscles and other serious symptoms, and there was an explosion in the electric culvert, accompanied with dense, black smoke and a non-luminous blue flame which lifted the heavy iron covers of the junction boxes. The whole evidence is interesting reading, as it renders the cause of the accident fairly clear, and certainly proves the absence of any contributory negligence, either legal or *de facto*, on the part of the gas company. But my special point is that the engineer of the electric lighting company, who ought to have known better, endeavored to force the mere fact of an explosion accompanying the discharge as an actual proof of joint liability on the part of the gas company. But the government inspector, Major Cardew, promptly rejected this view, giving an explanation of how electricity might cause an explosion in the entire absence of inflammable gas. He further remarked that the gas company was not represented at the inquiry, and he knew of no reason why they should expect to be called into question, and plainly added that the electric company came after the gas company and that it was their duty to keep their own conduits free from gas. The counsel for the electric company submitted that the explosion could only have been caused by leakage of gas or by leakage of water, but the inspector also overruled this limitation, and further stated that there was no evidence of the presence of gas in the culvert before him. But the matter did not rest here, for on the following day Mr. Foulger, Chief Distributing Engineer to the Gas Light and Coke Company, attended the inquiry, and emphatically contradicted the suggested presence of coal gas at the scene of the explosion. With this evidence on record, there is proof that nothing short of positive evidence is sufficient to implicate the gas companies in disasters of this sort. The report of the government inspector is not yet published, and, therefore, it will be better to hold over further remarks as to the actual issues concerned.

A considerable space has lately been occupied in our t chnical journals by a discussion on the subject of gas fires for bed-rooms in hotels. It has been suggested by the success of the prepayment coin meter, and the idea is that the guest or lodger (which is the proper word?) should insert a coin in the slot and thus secure the use of a comfortable gas fire. That this should be an advantage in several respects need not be pointed out. On a recent occasion the writer arrived at a small town at midnight, at the close of a seven hours' railway journey, and after 15 minutes' walk in pouring rain, and a similar pause under the portico before the porter could be roused, was shown into a cold bed-room. A modest inquiry with reference to whiskey was met by the crushing reply that the bar was locked up. His reflections, as he prepared for bed, ran very strong on this gas fire business. The chief difficulty is that of time. The appliance would require to accommodate the demand for a fire just to warm the room—say to burn one hour—and also to extend to about 10 hours' consumption for all night use. A penny would meet the first case. But neither an ordinary supply of pennies nor of patience would be equal to the second. Perhaps the best ways of meeting this demand would be a simple time appliance, to be set by the attendant, or else by a prepayment meter pure and simple. But as hotel proprietors would probably object to invest in a hundred meters or so, it would seem that a time arrangement consisting of a separate mechanism for each tap, or perhaps of an electric or pneumatic contrivance controlled from the night porter's office, is the most practical direction in which to look. Such an appliance, if once established, would be largely used in offices, chambers and by young men in lodgings.

1. See JOURNAL Dec. 2, 1894, p. 911.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. CHRISTOPHER E. NEWMAN, who has filled the position of Secretary to Mayor Ellert, of San Francisco, Cal., for the past two years, has been appointed Gas and Water Inspector. He assumed the duties of his new place on the 15th inst.

MR. H. S. WHIPPLE, Supt. of the American Gas Company's plant at Rockford, Ills., has sold and placed over 1,000 Welsbach lamps in that city since May 1st, 1894; and the best of it is that he sold a greater number of the lamps to customers of the local electric companies than to the regular patrons of the Gas Company. The result is that about 45 arc lamps and over 200 incandescent electric lamps have been replaced by Welsbachs, although the electric light people did cut their rates $20 per arc per annum.

THE Berlin Iron Bridge Company, of East Berlin, Conn., has just completed a new boiler house for the Metropolitan Electric Company, at Reading, Pa.

A CORRESPONDENT at Louisville, Ky., forwards the following: "Some time ago Chancellor Edwards handed down his opinion in the cases of Dulaney & Alexander and Colonel H. L. Stone, who refused to pay a meter rent demanded by the Gas Company—if I mistake not the cases were mentioned in the JOURNAL when the proceedings were first instituted. In any event, the suit of Dulaney & Alexander was entered some time ago, and a temporary injunction had been granted them, when Colonel Stone, who resides at 23d and Ormsby streets, filed his petition. The actions were heard together, as the same points were involved. In deciding the cases the judge said that the Company had no right to charge meter rent in addition to the maximum charge of $1.35 per 1,000 cubic feet, as it was presumed from the charter of the Company that its gas rate covered all charges for gas that could be made. In fact, the Company, from its point of view, could charge something in the shape of interest on every portion of its plant, were the justice of charging interest on a meter admitted. The Directors of the Company, at a special meeting held to consider the Chancellor's decision, determined to appeal the case to the Appellate Court. The Company does not make a general practice of charging a meter rent, the tax applying only in case the consumer on whose premises a certain size of meter is set fails to use a specified quantity of gas each month; and it is probable that the chief reason for the rent is the desire to cause users of electric lights, who only have gas laid down for the purpose of insuring themselves illumination in case of the failure of that light, or to eke out the same, to pay a sum sufficient to insure the keeping of the meter in working order." The meter rent schedule of the Company is appended:

Size of Meter.	Consuming Cu. Ft. per Month, or Less.	Cents per Month.
3-light	500	10
5 "	800	12
10 "	1,000	15
20 "	1,200	17
30 "	1,500	20
45 "	1,800	22
60 "	2,000	25
80 "	2,500	30
100 "	3,000	35

THE proprietors of the St. Croix (Me.) Gas Light Company have arranged for the placing of an incandescent electric lighting plant, which is to supply current to the adjoining centers of Calais, St. Stephen and the two Milltowns.

MR. A. B. COLFMAN, Agent for the Martinez (Cal.) Gas Company, has set up Welsbach burners for outdoor lighting in the street lamps on Ferry street, from the railroad depot to Ward street, and on Main street, from Castro to Smith streets, at the request of the Martinez Board of Town Trustees.

A PRETTY cool proposition is that submitted by Mr. King (formerly of the firm of Coates & King, of Montreal, who started the Consumers Gas Company in that city, and which was subsequently sold out root and branch to the Montreal Gas Company) to the City Council. He (Mr. King) says he "likes the climate and the people, and is willing to build works that will cost $1,000,000." No doubt; no doubt. In the meantime, why does not Mr. Coates come forward with another proposition?

THE Valparaiso Gas Company, of Valparaiso, Ind., which has been operated for years with such success by Mr. J. W. Stratton, has been consolidated with the Valparaiso Electric and Incandescent Light Company, the new enterprise being capitalized in the sum of $120,000. The corporate name is that of the Valparaiso Gas and Electric Company, and its officers are: President, E. C. Noe; Vice-President and Manager, J. W. Stratton; Secretary and Treasurer, C. A. Sweet—Mr. Sweet was the leading spirit in the Electric Company. The Company has wisely concluded to open an office in the down town district of the city.

THE Buffalo (N. Y.) Meter Company—its specialty is to be the manufacture of water meters—has been incorporated by Messrs. George B. Bassett, C. M. Harrington and E. M. Bassett, all of this city. It is capitalized in $25,000.

THE Clinton (Mass.) Wire Cloth Company has just completed a new boiler house, the roof of which is covered with the Berlin Iron Bridge Company's patent anti-condensation corrugated iron.

THE Albany (N. Y.) Council has authorized the Contracting Board to expend $250 in equipping the office of City Engineer with the apparatus necessary for testing the quality and illuminating power of the gas supplied to the city. Certainly the appropriation is modest enough, in point of economy.

THE proprietors of the Rockford (Ills.) Gas Company have offered a reward of $10 for the apprehension of anyone caught breaking the glass of a public lamp.

"OBSERVER" forwards the following: "The Hon. Orlando S. Bailey, of Amesbury, Mass., for many years Secretary of the Amesbury and Salisbury Gas Company, died at his residence on School street on the forenoon of the 20th December. He had been ill for a long time. Deceased was born in Amesbury 76 years ago, and for 50 years was intimately connected with the history of his birthplace. He represented Amesbury in the State Legislature of 1861, which service was followed by a period of active engagement in the war of the rebellion. In 1867-8 Mr. Bailey was an appraiser in the Boston custom house, and was afterwards trial judge at Amesbury for many years previous to the establishment of the Second District Court. In 1891 Mr. Bailey was appointed probation officer by Judge Cate, of the last named Court, which office he held at the time of his death. He was also Secretary of the Amesbury and Salisbury house for aged women. In all reforms and movements for the advancement of his birthplace he was prominent. He was a mmber of the Main street Congregational Church for many years and also a member of Powow River Lodge of Odd Fellows. He leaves two sons."

AT a recent meeting of the Richmond (Va.) Cohncil Committee on Light, Mr. E. D. Starke, as Chairman of the sub-committee on gas stoves, submitted a report stating that the proposition of Mr. G. J. Roberts, of Philadelphia, to furnish gas cooking stoves to the citizens of Richmond at cost, provided the city would allow him a commission of 5 per cent. upon all gas consumed by such stoves, had been duly considered, and recommended its rejection. The sub-committee took the ground that the Richmond merchants would carry in stock a full line of such goods, and would sell them at only a small profit. The report was received and filed.

THE Directors of the Selma (Cal.) Gas and Electric Light Company have virtually determined to again start up the gas division of that enterprise, which was closed down some time ago because of the high price of gas making materials in that section. After experimenting, however, in the matter of supplying electric currents, Mr. Eggers (a resident of Fresno, who is the principal owner of the Selma Company), and his associates, have reached the conclusion that if gas making is a costly process in Selma, the generating of electric currents there is at least as expensive.

ACCORDING to the claim made by the Selectmen of Newton and Watertown, the Newton and Watertown Gas Light Company has encroached unduly upon a public landing place upon Water street, which location fronts on the Charles river. The landing place has been in existence for years, and the authorities labor under the belief that the Company's plant encroaches on the border line. Some days ago the Company, through its counsel, Mr. W. F. Bacon, appeared before the Supreme Court and petitioned Judge Morton for the appointment of Commissioners to take the testimony of Joseph W. Bacon, of Newton, and Gardner G. Hubbard, now of Washington, D. C., two residents of the town of years ago. In the event of the "ancient plan" affecting the condition of the two respective places, the Company can easily show that for 40 years its present buildings have been standing on the disputed

land, which occupancy will undoubtedly establish its title of permanent ownership. Judge Morton will name the Commissioners as requested.

AT a recent meeting of the Waterbury (Conn.) Board of Aldermen the following resolution was adopted: "*Voted*, That the City of Waterbury, under the act of the General Assembly passed at the sessions thereof held 1893, authorizing cities and other municipalities to establish plants for the manufacture of gas and electricity, will as soon as possible and convenient, construct, purchase, lease and establish and maintain within its limits a plant or plants for the manufacture and distribution of gas or electricity for furnishing light for municipal use, and for the use of such of its inhabitants as may require and pay for the same."

MR. W. M. WILSON, who superintends the properties of the Garland County Investment Company, which properties include the Hot Springs Water Company, the Garland Gas Light Company, and the Hot Springs Electric Light Company, of Hot Springs, Arkansas, is authority for the statement that the business of gas supply in that section is fairly good. He is not so enthusiastic over the electrical possessions of the Company, however. The water works division is growing with great rapidity, large expenditures in its perfecting having been made this season. A new dam was constructed and a 2,000,000 gallon pump was installed, and about two miles of 6, 8 and 12-inch mains were laid.

A "TRAVELING MAN" forwards the following: "That the work of the United Gas Improvement Company is bounded by no geographical lines is well shown by its recent contract with the Citizen's Gas, Heat and Light Company, of Ocala, Florida, some details of which are given herewith. Ocala, situated in almost the exact center of that far-off State, enjoys a business prosperity beyond that coming from the winter tourist trade only, so often the chief dependence of the average Florida town. Located in the heart of the region of rich phosphate deposits, its trade and banking businesses show unusual volume therefrom, and are augmented still further by timber and orange interests—the local variety of orange is said to equal the far-famed Indian river brand. Topping all this is the recent movement of cigar factories to Ocala from Key West and Tampa, several concerns having already located, with other like ventures in prospect. The city—a junction point of both the 'Plant and Peninsular' railroad systems—has been styled the 'Brick City,' from the number and character of the brick business blocks located around the public park and Court House. Compactly built, regularly laid out, and with a beautiful residential portion, there is an evident business activity in its streets which impresses the visitor as being beyond that of the average Florida town, and strongly suggests the proverbial rustling communities of the West. With all this in mind, it is easy to understand that a local gas project was but a matter of time, and the sporadic efforts of the past culminated this fall in two applications for franchises. The surviving one—the Citizens' Gas, Heat and Light Company—was strictly what its name implies, an organization of citizens, free from outside influences, process promoting, or a 'one-man-power' taint, having the *bona fide* object of being a local company, owned by local people, in many distributed blocks of stock. The earnest of their intention was shown by posting a $1,000 absolute forfeit in case of not going ahead. The charter was applied for October 22d, and issued November 23d, contracts having been made in the meantime for the machinery. That those in the Company are the best men in the city is shown by the names of such men as J. V. Burke, largely interested in Ocala's phosphate and timber interests; E. W. Agnew, having the largest hotel, banking and commercial concerns in the place; W. S. Bullock, a leading attorney; Mr. H. S. McKay, architect and contractor, and Messrs. Miller, Pearson, McIntyre, Crawford, Waterman, McGrath, Newsom, Campbell. Izlar and Davis, each of whom is a leading man in the city, and all of whom are charter members of the Company. In fact, the only outsider in the whole Company is Mr. R. P. Manley, of Dalton, Ga., a leading constructor of modern steel jails throughout the South, who acted as advisory engineer in the practical details of the gas works construction. The contract for the entire gas works was placed with the United Gas Improvement Company, of Philadelphia, whose offer afforded the best design and fullest equipment at the lowest figures in the competition—four separate builders took part in the competition. The machinery covered is the Company's well-known form for small works, of the 'Standard Lowe' water gas apparatus, with 8-inch connections, and a capacity of 75,000 cubic feet daily. The outfit, of course, includes all the necessary auxiliary machinery and apparatus, such as boilers, engines, storage oil tanks and piping of all sorts. The purifying equipment will balance, and the initial gasholder capacity will be 25,000 cubic feet. The general design of the works covers suitable shop, office and station meter rooms, and arrangements have been made for the duplication and extension of any part as the growth of Ocala's business may warrant. The plant, in fact, is a model one of its size, remarkably well designed for ease of working and economy of manufacture, which, however, are the features accompanying that which the United Gas Improvement Company is responsible for. I might have said before that the site chosen is an exceptionally good one, in that it is adjacent to both railroads, with a switch from each. It is expected to signalize this new enterprise with a brilliant illumination of the streets by means of the modern Welsbach burner that will cause the present irregular electric lighting not to be 'in it' by comparison. It is hoped to turn the gas on to the city's mains about Washington's birthday, or not later than the 1st of March. Ocala is to be congratulated on at last having provided for a good gas service and to be controlled by a home citizen Company. All will join in the hope that the promoters of the Citizens Company will receive good, snug returns on their investment; and there is no reason to doubt that such will be their reward."

THOSE interested in the gas supply of Fall River, Mass., are moving in the matter of making an absolute consolidation of every interest of the two existing Companies.

THE Board of Supervisors of Montgomery county, N. Y., have decided that the lighting of the new armory at Amsterdam, N. Y., shall be by gas.

THE annual election of the Oneida (N. Y.) Gas Light Company resulted in the following executive management: Directors, George Berry, S. H. Farnam, D. H. Walrath, H. S. Klock and W. E. Northrup; President, W. E. Northrup; Secretary and Treasurer, H. S. Klock; Collector, A. D. Hamlin.

MR. R. R. DICKEY, President of the Dayton (Ohio) Gas Light and Coke Company, is authority for the statement that that property is not for sale. It still remains the fact that a syndicate is extremely anxious to secure control of it.

THE proprietors of the Nevada City (Cal.) Gas Company have decided to install an electric lighting plant for the supply of arc and incandescent lamps.

MR. JAMES BELL, who was one of the promoters of the Peoples Gas Light Company, of Paterson, N. J., died at his home in that city on the morning of December 18th. He was in his 60th year, and leaves a wife and a son.

THE Eclipse Gas Stove Company, of Rockford, Ills., has been incorporated by Mr. George S. Roper and Mrs. Kate B. Roper. It is capitalized in $25,000.

THE new office building of the Indianapolis Gas Company, which is to replace the building destroyed by fire some weeks ago, is to be one of the noted structures of that city. It is to be of steel and stone, 10 stories in height, on a plot 70 feet by 185 feet. The estimated cost is $225,000, and it will be ready for occupancy next fall.

THE Mohawk Gas Company is the title of the concern which has succeeded to the rights and privileges of the Schenectady (N. Y.) Gas Company.

THE plant of the new Nanticoke (Pa.) Gas Company is now furnishing gas regularly to those on its lines.

THE public lighting of Erie, Pa., has been awarded to the Erie Gas Company, at its bid of $18.50 per lamp per annum, plus $3 a lamp for lighting and extinguishing, provided the number of lamps maintained under the agreement is not less than the maximum number maintained last year.

MR. HENRY V. PUGH, Chief Inspector of Meters, Spring Garden division of the Philadelphia Gas Bureau, died on the 19th inst.

ACCORDING to the Boston *Herald* an equity suit has been brought by Henry S. Jackson, of Boston, against Jas. R. Kendall, of Terre Haute, Ind., and the Waltham (Mass.) Gas Light Company, in the equity session of the Superior Court, before Chief Justice Mason. The plaintiff claims that he is entitled, under a contract with Kendall, to $2,000, which sum is said to represent one-half the profits made upon the establishment by the Waltham Gas Light Company of the Kendall gas system. He alleges that he and Kendall made a contract by which he was to have one-half the profits on all his sales of the Kendall system of gas lighting in New England, and that he made the sale to the Waltham Company. He further states that the Company still owes the defendant Kendall $3,750 under its contract with the latter, and he asks the Court to apply this to the payment of the claim. Kendall's defense is that he made the sale to the Waltham Company himself.

The Market for Gas Securities.

Consolidated sold off a trifle during the week, the decline evidently being the result of realizing sales. The opening to-day (Friday) was made at 131⅞ bid, offered at 132½, and if appearances count for anything the tendency is toward lower prices. New York and East River common was also dull and weak, the common showing a decline of 6 points in the bid price from that of last week. Purchasers offer 30 for it, while holders ask 33. The publicity given to the thought that prominent owners in other city Gas Companies have been dipping heavily into East River common has evidently disturbed the plans of such buyers, who know very well how to put quotations down as well as up. In our belief East River common is a purchase at the current offering price. Other city shares are strong, particularly Mutual and Standard common.

There is no change in the Brooklyn situation, although the tendency is again towards higher quotations, which, however, are largely nominal. Chicago gas, in the opening quotations for the morning, shows a gain for the week of 2½ points. Bay State continues to decline, and Baltimore Consolidated is somewhat easier. Jersey City gas is bid for at 190, and Peoples, of the same city, is firmly held, at 167 bid.

Gas Stocks.

Quotations by Close & Nash, Brokers and Dealers in Gas Stocks.

35 Wall St., New York City.

December 31.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid	Asked
Consolidated	$35,430,000	100	131⅞	132½
Central	500,000	50	103	—
" Scrip	220,000	—	100	--
Equitable	4,000,000	100	182	187
" Bonds	1,000,000	—	107½	—
Metropolitan, Bonds	658,000	—	108	112
Mutual	3,500,000	100	153	155
" Bonds	1,500,000	—	100	102
Municipal, Bonds	750,000		—	—
Northern		50	—	—
" Bonds	150,000	—	—	100
N. Y. & East River Gas				
Common	5,000,000	100	30	33
Preferred	2,000,000		45	48
Bonds	3,500,000	100	88	88½
Richmond Co., S. I.	348,650	50	50	—
" Bonds	100,000	—	—	—
Standard Gas Co—				
Common Stock	5,000,000	100	40	41
Preferred	5,000,000	100	86½	90
Yonkers		50	112	—
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	120	—
Citizens	1,200,000	20	60	—
" S. F. Bonds	320,000	1000	—	101
Equity Gas Light Co	2,000,000	100	—	—
Bonds	1,000,000	—	—	—
Fulton Municipal	3,000,000	100	175	—
" Bonds	300,000		103	—
Peoples	1,000,000	10	85	—
" Bonds (7's)	368,000	—	100	—
(6's)	94,000	—	98	100
Metropolitan	870,000	100	160	—
" Bonds (5's)	70,000	—	—	155
Nassau	1,000,000	25	200	—
" Ctfs	700,000	1000	99	100
Williamsburgh	1,000,000	50	200	—
" Bonds	1,000,000	—	107	110
Out of Town Gas Companies.				
Bay State Gas Co.—				
Stock	5,000,000	50	17⅞	18
Income Bonds	2,000,000	1000	44	45
Boston United Gas Co.—				
1st Series S.F. Trust	7,000,000	1000	80	83
2d " " "	3,000,000	1000	59	—
Buffalo Mutual, N. Y.	750,000	100	120	—
" Bonds	200,000	1000	95	100
Chicago Gas Company.	25,000,000	100	73⅜	73¾
Chicago Gas Light. & Coke Co.—				
G't'd Gold Bonds	7,650,000	1000	93	93½
Consumers Gas Light Co., Jersey City	2,000,000	100	68	73
Bonds	600,000	1000	92	95
Cincinnati G. & C. Co.	7,000,000	100	202	204
Consumers Toronto	1,600,000	50	184½	187
Central, S. F., Cal			90	100
Capital, Sacramento, Cal			—	50
Consolidated, Balt	11,000,000	100	65½	—
" Bonds	6,400,000		107	107½

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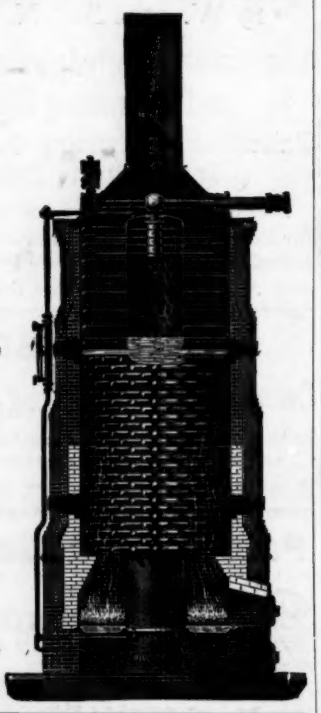

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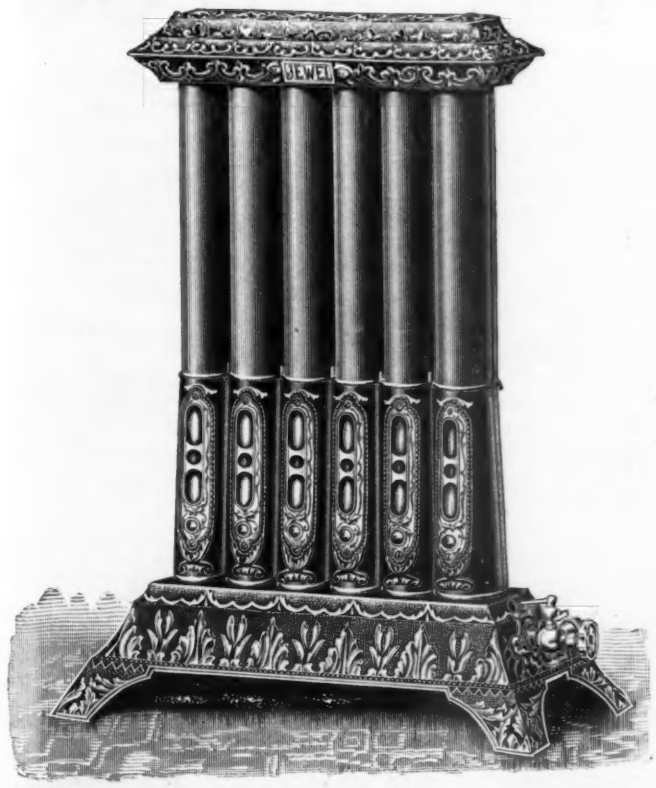

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Letters and References.

OIL CITY, PA., March 3, 1894.
THE PENNSYLVANIA GAS FURNACE CO.: Dear Sirs—In regard to the furnaces put in, will say they are giving excellent satisfaction so far. Am very much pleased with them. The reason that I did not write you sooner was that they had not been in long enough to say much about them. They are certainly great gas savers.
Yours respectfully, FRED. N. CHAMBERS.

JAMESTOWN, N. Y., Feb. 16, 1894.
THE PENNSYLVANIA GAS FURNACE CO.: Dear Sirs—The furnace put in my house by Wilson & Van Tuyl, of this city, gives entire satisfaction. Considering the cost of the furnace and its great saving qualities, I think it par excellent. Yours truly, P. C. HOUSTON.

KANE, PA., 3, 5, 1894.
THE PENNSYLVANIA GAS FURNACE CO.: Dear Sirs—Your letter in regard to heater received. I have been away for two weeks, hence the delay. The heater gives perfect satisfaction; heats ten rooms and three halls sufficiently. I am very much pleased with it.
Very respectfully, J. L. WRIGHT.

DU BOIS, February 22, 1894.
THE PENNSYLVANIA GAS FURNACE CO.: Dear Sirs—The gas furnace got from you could not well be improved, and it has given perfect satisfaction. Yours respectfully, C. D. GRAY, Prest. Board Trustees.
We heartily indorse the above statement.
J. S. BURLY, J. W. GOODWIN, Church Janitors.

FALLS CREEK, PA., 1, 19, '94.
THE PENNSYLVANIA GAS FURNACE CO.: Dear Sirs—In reply to your inquiry of the 17th inst. in regard to the gas furnace that you put in our church, would say the furnace has given excellent satisfaction, and is all we could wish it. Yours truly, J. F. REED.

DU BOIS, PA., Feb. 12, '94.
THE PENNSYLVANIA GAS FURNACE CO.: Dear Sirs—The furnace I bought from you gives excellent setisfaction, and is doing more than we expected. Yours, D. L. CORBETT.

WARREN, PA., Feb. 23, 1894.
THE PENNSYLVANIA GAS FURNACE CO.: Dear Sirs—Your gas furnace is giving entire satisfaction. I am very much pleased with it. It is a saver of gas and makes a great quantity of heat.
Yours truly, J. D. EDDY.

OIL CITY, PA., April 6, 1894.
THE PENNSYLVANIA GAS FURNACE CO.: Gentlemen—In reply, would say your furnaces in my church give great satisfaction.
Yours truly, THOMAS CARROLL, Pastor.

WARREN, PA., March 1, 1894.
THE PENNSYLVANIA GAS FURNACE CO.: Gentlemen—Your furnaces are working well. Yours truly, W. L. MACGOWAN.

WARREN, PA., Feb. 17, '94.
THE PENNSYLVANIA GAS FURNACE CO.: Dear Sirs—The Pennsylvania Gas Furnace which you set up in my residence last year is satisfactory in all respects. I think it one of the best furnaces in the market. Yours truly, MRS. S. A. WETMORE.

JAMESTOWN, N. Y., Feb. 16, 1894.
THE PENNSYLVANIA GAS FURNACE CO.: Dear Sirs—In reply to yours of the 8th inst., in regard to my opinion of your gas furnace, I would say that I am very well pleased with it.
Very truly yours, C. B. YATES.

JAMESTOWN, N. Y., Feb. 16, 1894.
THE PENNSYLVANIA GAS FURNACE CO.: Dear Sirs—The gas furnace bought of you is working satisfactorily. Yours truly, C. C. WILSON.

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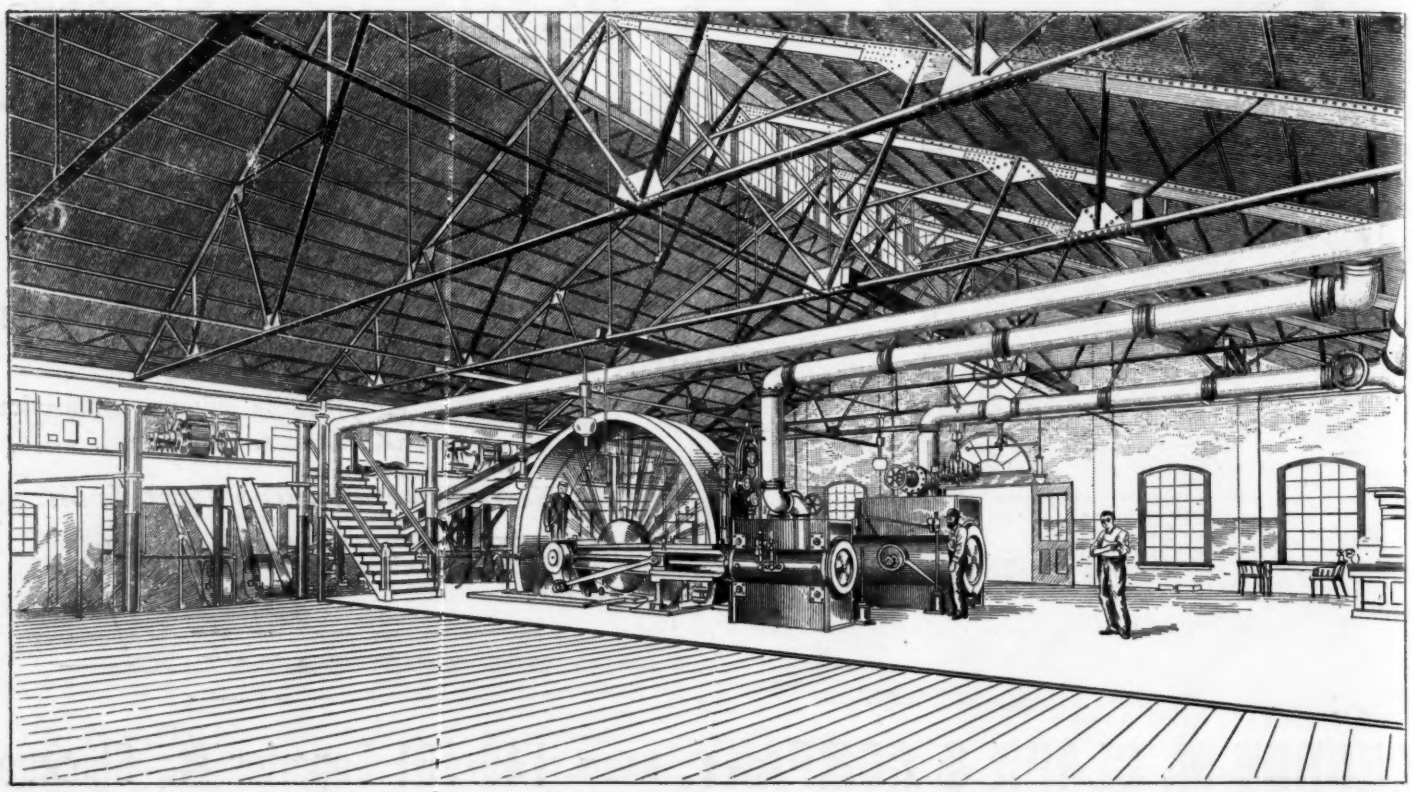

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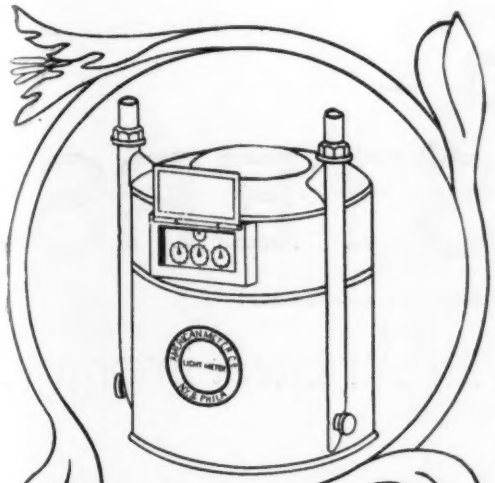
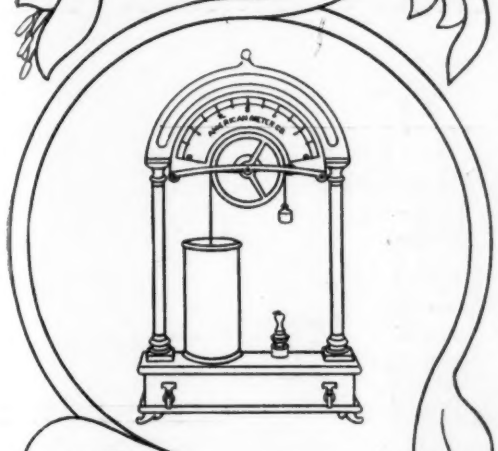
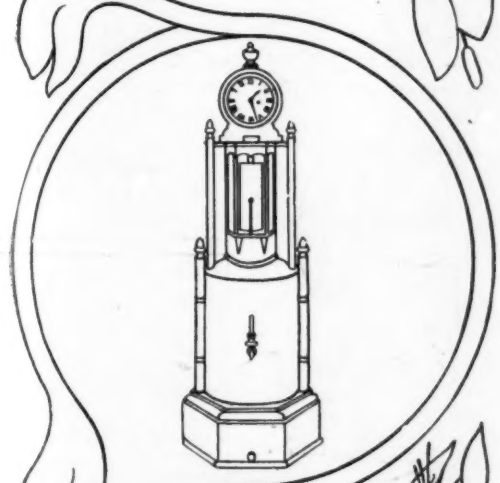
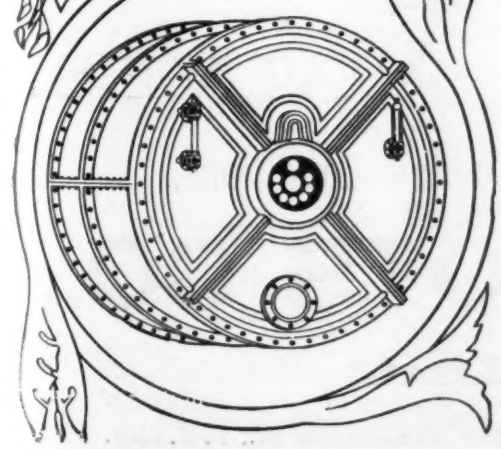








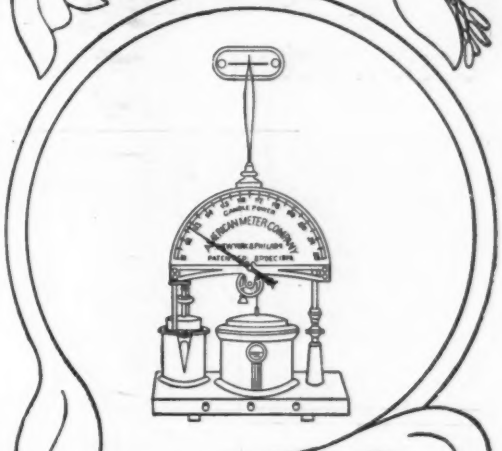
PUBLIC LIGHTING TABLE.

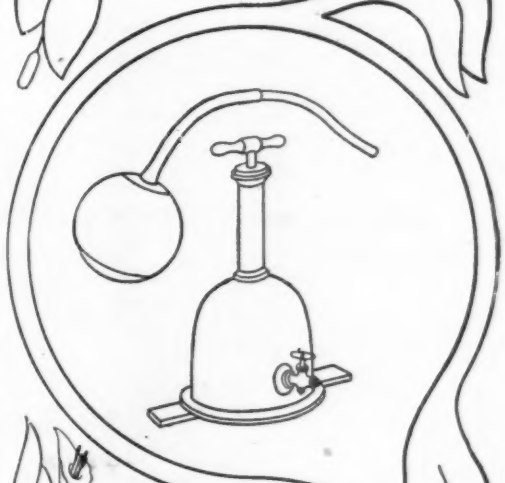
JANUARY, 1895.

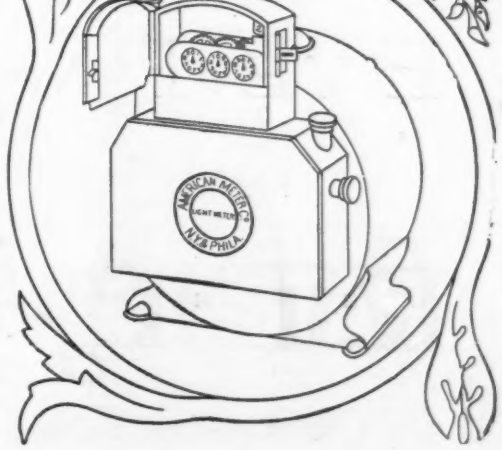
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Tue.	1	9.10 PM	6.20 AM	4.30	6.30
Wed.	2	10.10	6.20	4.30	6.30
Thu.	3	11.10 FQ	6.20	4.30	6.30
Fri.	4	12.10 AM	6.20	4.30	6.30
Sat.	5	1.20	6.20	4.30	6.30
Sun.	6	2.30	6.20	4.30	6.30
Mon.	7	3.50	6.20	4.30	6.30
Tue.	8	5.00	6.20	4.40	6.30
Wed.	9	No L.	No L.	4.40	6.30
Thu.	10	No L. FM	No L.	4.40	6.30
Fri.	11	No L.	No L.	4.40	6.30
Sat.	12	5.30 PM	7.40 PM	4.40	6.30
Sun.	13	5.30	9.00	4.40	6.30
Mon.	14	5.30	10.20	4.40	6.30
Tue.	15	5.30	11.30	4.50	6.25
Wed.	16	5.30	12.40	4.50	6.25
Thu.	17	5.30 LQ	1.50 AM	4.50	6.25
Fri.	18	5.30	3.00	4.50	6.25
Sat.	19	5.30	4.10	4.50	6.25
Sun.	20	5.40	5.20	4.50	6.25
Mon.	21	5.40	6.10	4.50	6.25
Tue.	22	5.40	6.10	5.00	6.25
Wed.	23	5.40	6.10	5.00	6.25
Thu.	24	5.40	6.10	5.00	6.25
Fri.	25	5.40 NM	6.10	5.00	6.25
Sat.	26	5.40	6.10	5.00	6.25
Sun.	27	5.40	6.10	5.00	6.25
Mon.	28	5.40	6.10	5.00	6.25
Tue.	29	5.40	6.10	5.05	6.15
Wed	30	9.00	6.10	5.05	6.15
Thu.	31	10.00	6.10	5.05	6.15

TOTAL HOURS LIGHTING DURING 1895.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	237.00	January	423.20
February	196.40	February	355.25
March	195.50	March	355.35
April	165.30	April	298.50
May	153.40	May	264.50
June	138.20	June	234.25
July	146.30	July	243.45
August	152.50	August	280.25
September	165.10	September	321.15
October	186.10	October	374.30
November	204.10	November	401.40
December	219.30	December	433.45
Total, yr.	2161.20	Total, yr.	3987.45







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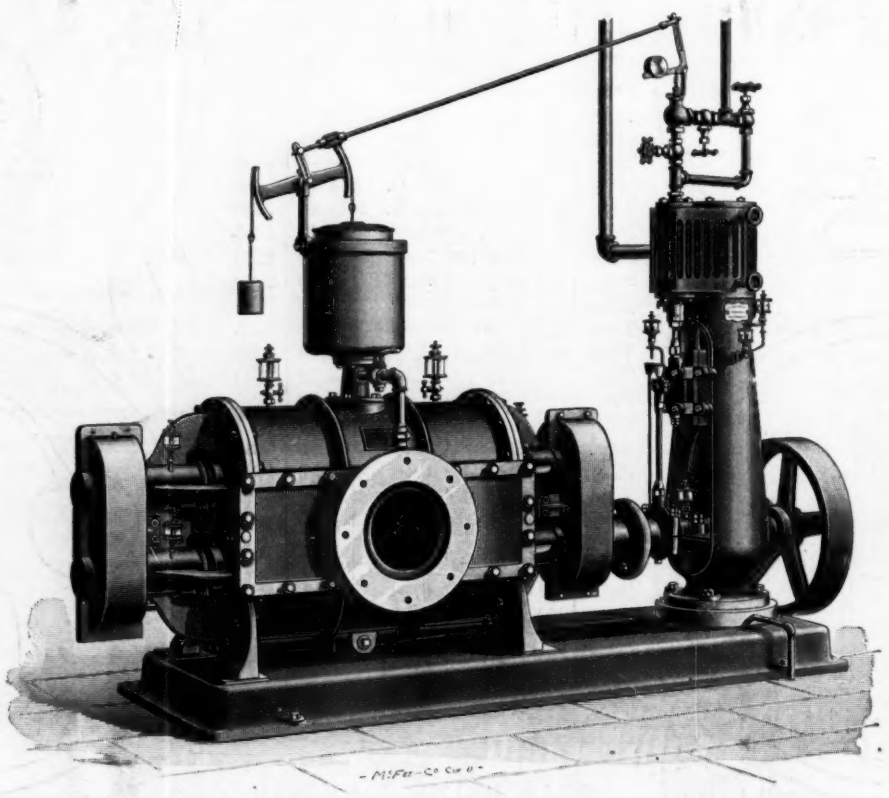

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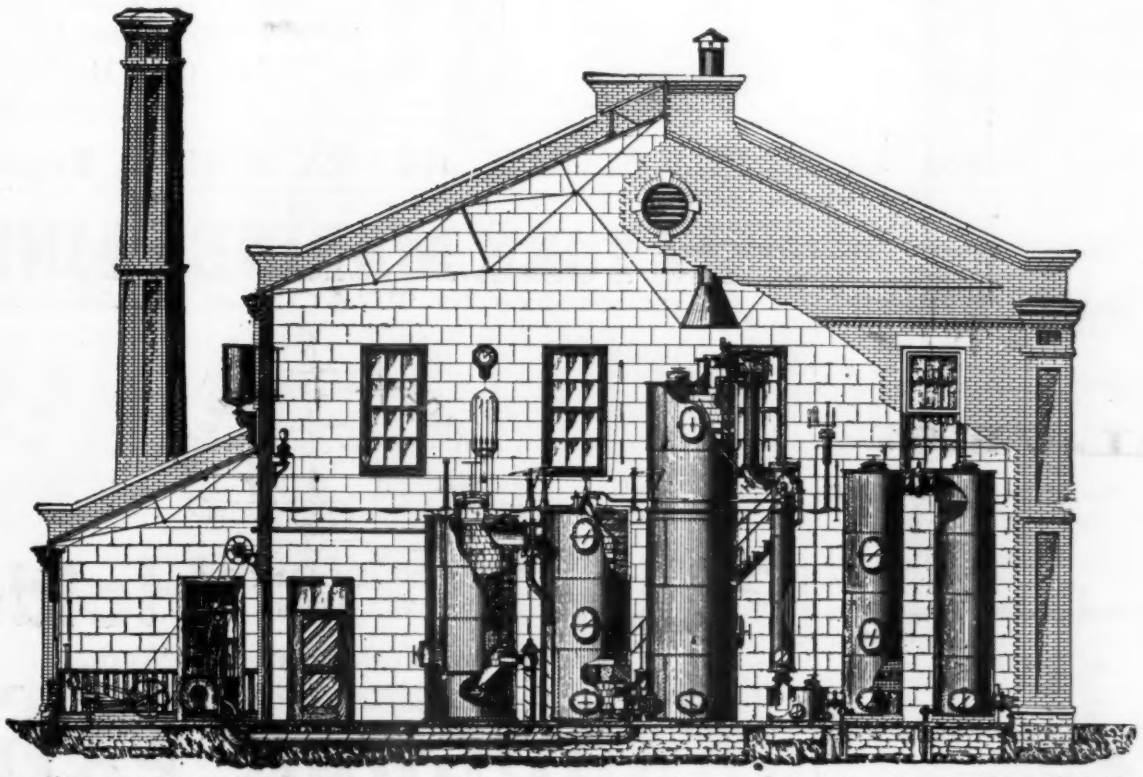

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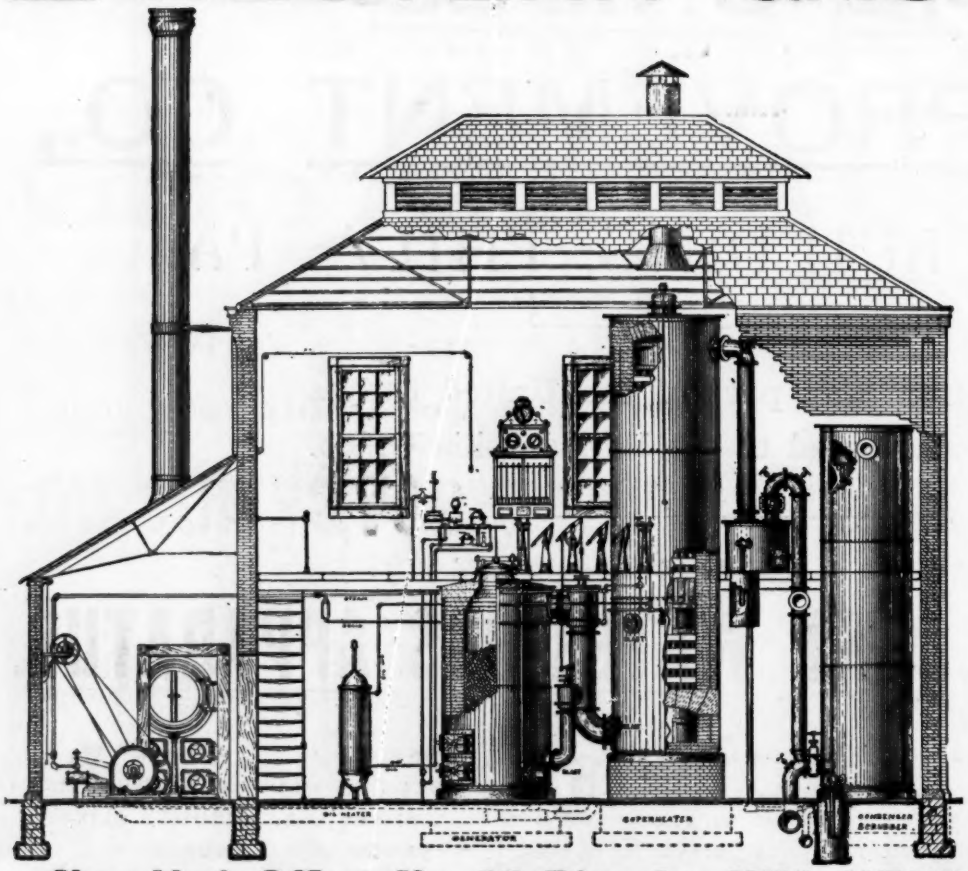

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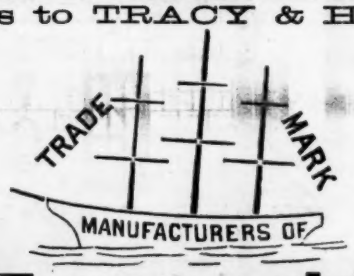

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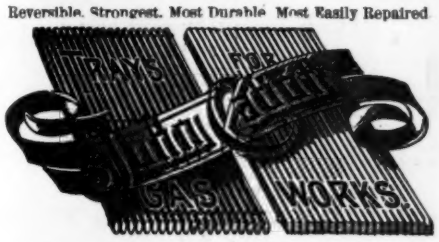

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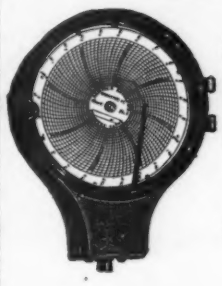

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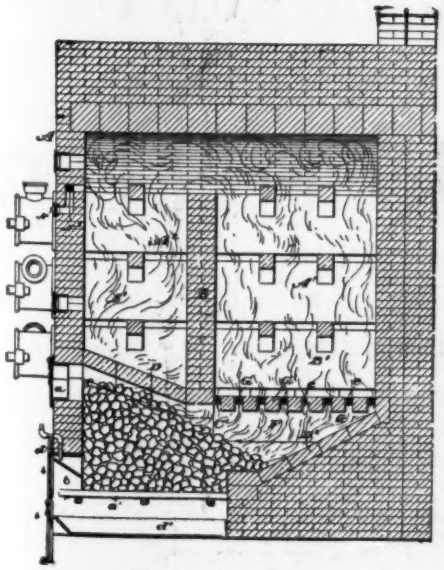

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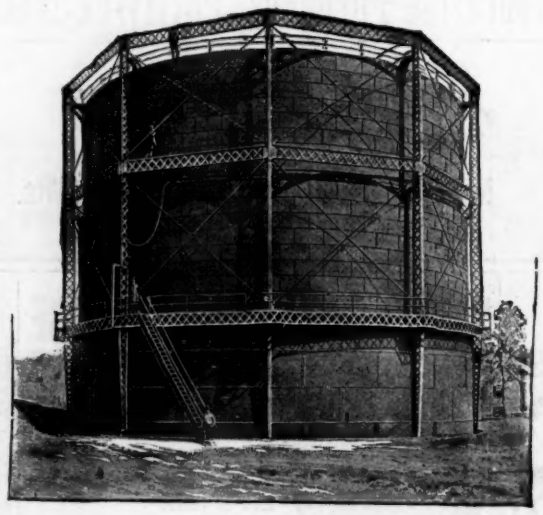

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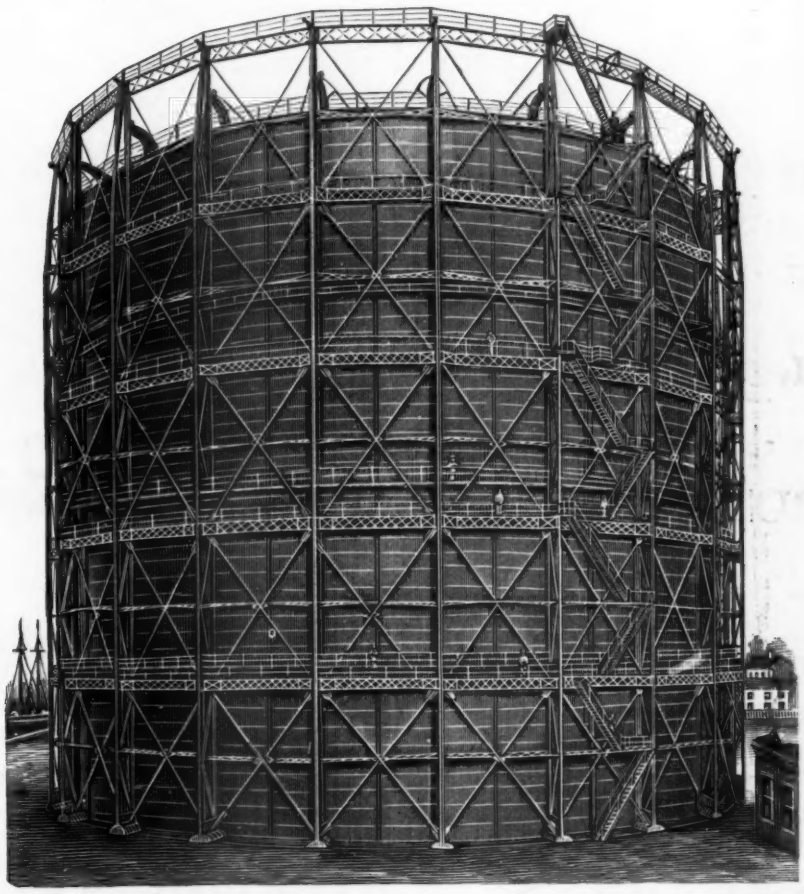

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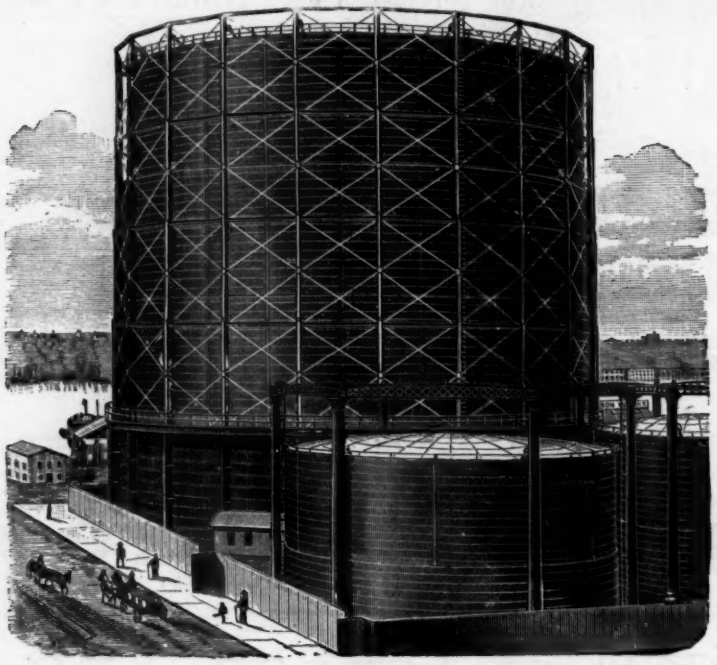

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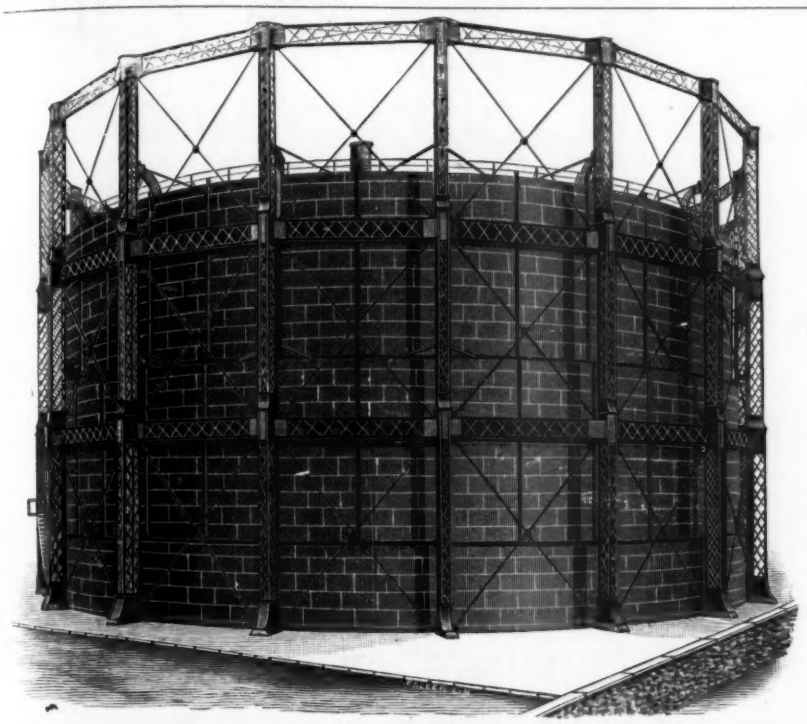

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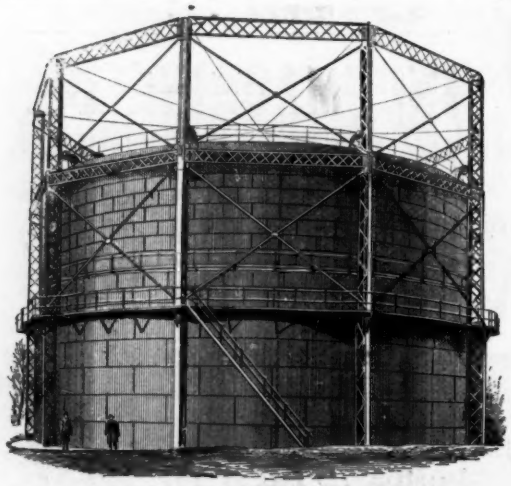

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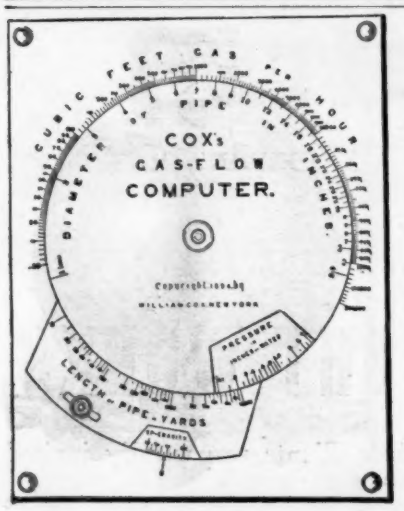

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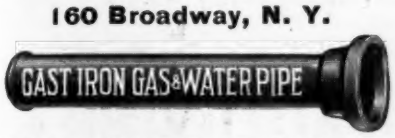

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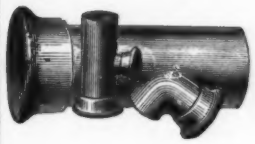

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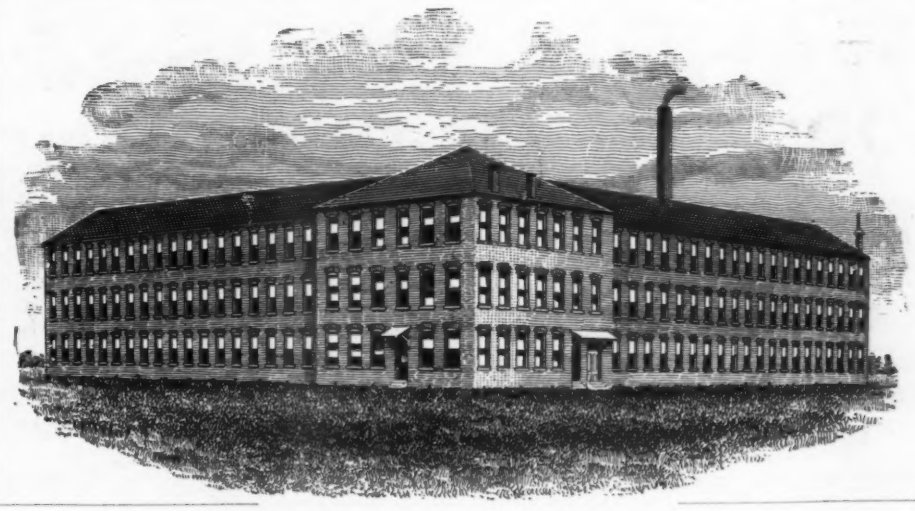

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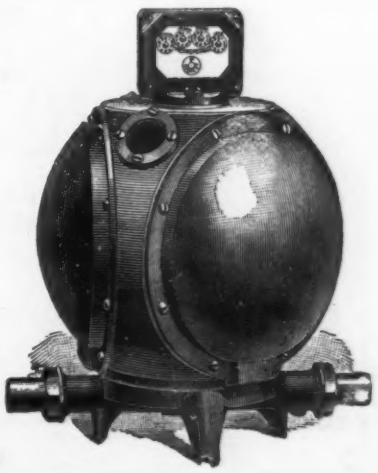

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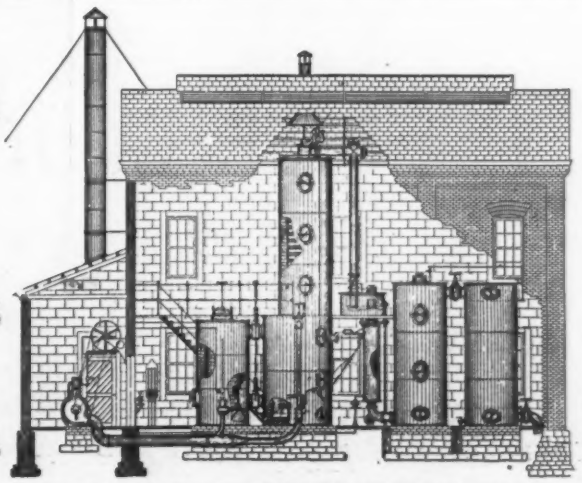

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